JAPANESE [JP,2003-188811,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS CORRECTION OR AMENDMENT

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] In the wireless bridge equipped with the wireless interface for transmitting a packet between network segments The means for choosing the bridge which should be connected according to communication link quality from other wireless bridges which are located on the outskirts and which can be communicated, and giving a logical port identifier to each connection bridge, the port number assigned to the network segments in a bridge, and the above — with two or more **/receive buffers which were prepared corresponding to the logical port identifier Between the transfer control means which transmits the packet stored in each above-mentioned receive buffer to which transmission buffer specified by the destination address, and other network segments The wireless bridge characterized by having a means for transmitting and receiving a packet through **/receive buffer, and the above-mentioned wireless interface of one of the above.
[Claim 2] The wireless bridge according to claim 1 characterized by for said grant means choosing the thing beyond the threshold to which signal receiving level was set beforehand as said connection bridge from other wireless bridges located on the outskirts, and giving a port number.
[Claim 3] The wireless bridge according to claim 1 where said grant means is characterized by choosing said connection bridge within the limits of the upper limit number as which signal receiving level was beforehand specified out of the circumference bridge beyond said threshold.
[Claim 4] The wireless bridge given in any of claim 1 - claim 3 they are where a specific logical port identifier and the corresponding transmission buffer for broadcasts are prepared, and said transceiver means is characterized by transmitting the packet for the object for broadcasting, or multicasts to other network segments using the transmission buffer for the above-mentioned broadcasts.
[Claim 5] In the wireless bridge which assigns a logical port identifier to the surrounding specific wireless bridge connected through a wireless interface, and controls the packet transfer between network segments by this port identifier **/receive buffer prepared corresponding to the port number assigned to the network segments in a bridge, Two or more **/receive buffers which were prepared corresponding to the logical port identifier assigned to the above-mentioned circumference wireless bridge, The transmission buffer prepared corresponding to the logical port identifier assigned to broadcasts, The transfer control means which transmits the packet stored in each above-mentioned receive buffer to which transmission buffer specified by the destination address, The port number for the above-mentioned circumference wireless bridges and the header addressed to a circumference wireless bridge which corresponds to the transmitting packet read from the corresponding transmission buffer are given. The wireless bridge characterized by having given the header for broadcasts to the packet read from the port identifier for the above-mentioned broadcasts, and the corresponding transmission buffer, and having a transmitting processing means to send out to the above-mentioned wireless interface.
[Claim 6] The wireless bridge according to claim 5 characterized by said transmitting processing means giving the MAC header which includes the junction place address and the self-bridge address for the address of said circumference wireless bridge, or the address for broadcasts as

the acting as intermediary agency address to said transmitting packet.
[Claim 7] The wireless bridge according to claim 5 or 6 characterized by performing grant of said header, and sending out in a wireless interface when it has a storage means for memorizing the multiple address address, said transmitting processing means collates the destination address of the packet read from the corresponding transmission buffer with the port identifier for said broadcasts with the multiple address address memorized by the above-mentioned storage means and it is in agreement with which the multiple address address.
[Claim 8] The storage means for memorizing the self-bridge address and the multiple address address, It has a reception means to store the receive packet from said wireless interface in the port identifier for said circumference wireless bridges, and which a corresponding receive buffer alternatively. The above-mentioned reception means collates the junction place address included in the header of a receive packet with the address memorized by the above-mentioned storage means. The wireless bridge according to claim 5 or 6 where the above-mentioned junction place address is characterized by storing the receive packet which was in agreement with the above-mentioned self-bridge address or which the multiple address address in the port identifier of the circumference wireless bridge which became the junction origin of this packet, and the corresponding receive buffer.
[Claim 9] It has a wireless interface and an interface for network segments. In the wireless section In the wireless bridge which manages a network configuration according to the spanning tree protocol which carried out packet communication in the MAC frame format of having followed IEEE802.11, and was specified to IEEE802.1D Two or more surrounding wireless bridges are received at broadcasting or the packet which should be carried out a multicast. The wireless bridge characterized by having a means for giving the MAC header which contains broadcasting or a multicast address as the junction place address, and sending out as a multiple address packet from the above-mentioned wireless interface.
[Claim 10] The wireless bridge according to claim 9 characterized by equipping communication link quality with the means for making thing selection more than predetermined level out of other wireless bridges located in grasp as a connection bridge set as the object of said spanning tree protocol.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the wireless bridge for performing individual communication link and broadcast alternatively among other surrounding wireless bridges in more detail about the wireless bridge for combining between two or more network segments by the radio channel.
[0002]
[Description of the Prior Art] Between two or more network segments which consist of cables LAN is connected by the radio channel, the packet generated in each segment is changed into the packet for wireless, and the wireless bridge is known as equipment for transmitting to other network segments. Moreover, the spanning tree protocol (Spanning Tree Protocol:STP) specified by IEEE802.1D is known as a communications protocol between the bridges in Cable LAN.
[0003] In STP, a network configuration (network topology) is recognized by transmitting and receiving the BPDU (bridge protocol data unit) frame with each input/output port of a bridge, and collecting the path cost information which expresses the path rate from the identification information and the root bridge of a connection place bridge for every port. When the loop-formation path exists all over a network, any on a loop-formation path or the network of the arborescence which made the root bridge top-most vertices when a bridge blocked the high pass of a path cost is constituted. The redundancy pass excepted from the network is built into a network as a detour of failure pass, when it becomes impossible to use a main path. In addition, on the bridge equipped with the STP function, each receive packet can be transmitted now to a destination address and the suitable corresponding network segment by learning the MAC Address of the receive packet in each port.
[0004] The protocol processing section of STP is controlling the packet transfer by the conventional bridge equipped with the STP function mentioned above per port, and the destination output port of a receive packet is determined as each port on it on the assumption that the specific network segment is connected, respectively.
[0005] being appropriate -- it is alike and can communicate with two or more surrounding wireless bridges with one wireless interface on a wireless bridge. In IEEE802.11, the access control of the wireless section is performed by CSMS/CA (Carrier sense multiple access with collision avoidance), and when transmitting data to the wireless section, each wireless bridge can be made to carry out the multi-access of the wireless circuit by specifying the MAC Address of the radio station which serves as a junction place by the header unit of a transmitting packet. That is, since one wireless interface corresponds with two or more radio stations physically, even if it is going to perform routing between a self-bridge and other wireless bridges in the protocol processing section of the conventional STP, application of STP of 1 network segment / 1 port becomes difficult.
[0006] For this reason, about a wireless interface, different port management from the LAN interface of a cable in which each has a specific destination bridge is needed. Identifying a logical port is proposed about this point by assigning a logical port for every communications partner of a wireless interface on the wireless bridge which mounted STP in 63rd page - 68 pages of the

**** technique RCS 99-24 (1999-05), and checking TA (Transmitter Address) contained in a frame header about the receiving frame from a wireless interface.
[0007]
[Problem(s) to be Solved by the Invention] As the above-mentioned reference shows, taking advantage of the function of the protocol processing section of the conventional STP, two or more wireless bridges which are different with one wireless interface, and an alternative communication link are attained by assigning a logical port for every communications partner of a wireless interface.
[0008] The packet communication in wireless space adds a MAC header, the packet frame, for example, Ethernet frame, on the cable LAN which forms each network segment, and is performed in the format of specifying a junction place bridge within a MAC header. Therefore, on a wireless bridge, the transmitting packet which was able to be distributed to each logical port by the protocol processing section of STP is changed into the MAC frame which specified the junction place bridge of a proper for every logical port, and is transmitted to other wireless bridges through a wireless interface. Moreover, if a packet is received from a wireless interface, each wireless bridge judges the junction place bridge address, if it is addressing to a self-bridge, will carry out reception and will perform transfer control in a bridge by the protocol processing section of STP.
[0009] Therefore, when performing broadcast which transmits the packet of the same contents to two or more terminals at coincidence like broadcasting or a multicast, according to the Prior art The protocol processing section of STP transmits the copy of the same packet to two or more logical ports for wireless interfaces. Two or more MAC frames which gave the different junction place address for every logical port are transmitted from a wireless interface. Each wireless bridge of a junction place will carry out reception of the MAC frame addressed to itself, and will transmit the multiple address packet of the origin extracted from the receiving MAC frame to each LAN segment. In this case, the problem referred to as causing the increment in the traffic in the wireless section and decline in the transfer efficiency of the message in each wireless bridge from the wireless bridge which became the agency acting as intermediary since two or more MAC frames which changed the junction place address are transmitted repeatedly occurs.
[0010] Moreover, in the wireless section, communication link quality is changed by environmental change. For this reason, on each wireless bridge, when the logical port mentioned above is beforehand assigned fixed corresponding to two or more wireless bridges of the circumference located within limits which can communicate, a message retransmission demand occurs frequently with generating of the reception error by degradation of communication link quality, and the problem referred to as causing the increment in traffic and the decline in the transfer efficiency of a message in the wireless section also has this.
[0011] The purpose of this invention is to offer the wireless bridge excellent in the transfer efficiency of the message in the wireless section. Other purposes of this invention are to offer the wireless bridge which can assign the logical port to a wireless interface appropriately. Especially the purpose of further others of this invention is to offer the wireless bridge which can transmit multiple address packets, such as broadcasting and a multicast, efficiently.
[0012]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the wireless bridge of this invention Communication link quality makes thing selection more than predetermined level out of other wireless bridges located in grasp. It considers as the connection bridge set as the application object of a spanning tree protocol (STP), And two or more wireless bridges are received at broadcasting or the packet which should be carried out a multicast. The MAC header which made broadcasting or a multicast address the junction place address is given, and it is characterized by sending out as a multiple address packet from a wireless interface.
[0013] If it explains in full detail, furthermore, the wireless bridge by this invention The means for choosing the bridge which should be connected according to communication link quality from other wireless bridges which are located on the outskirts and which can be communicated, and giving a logical port identifier to each connection bridge, the port number assigned to the

network segments in a bridge, and the above -- with two or more **/receive buffers which were prepared corresponding to the logical port identifier Between the transfer control means which transmits the packet stored in each above-mentioned receive buffer to which transmission buffer specified by the destination address, and other network segments It is characterized by having a means for transmitting and receiving a packet through **/receive buffer, and the above-mentioned wireless interface of one of the above.

[0014] One description of this invention is by preparing a specific logical port identifier and the corresponding transmission buffer for broadcasts to transmit the packet for the object for broadcasting, or multicasts to two or more connection bridges at coincidence.

[0015]

[Embodiment of the Invention] Hereafter, the case where the wireless bridge of this invention is applied to the wireless LAN of IEEE802.11 specification is explained. IEEE802.11 is the specification about the physical layer and MAC (Media Access Control) layer of wireless LAN, and the MAC layer corresponds with the lower layer of the data link layer in an OSI reference model.

[0016] Drawing 1 shows one example of the wireless LAN to which the wireless bridge of this invention is applied. Wireless LAN consists of two or more wireless bridge 10-i (i=1-5), it connects with two or more terminals PCi1 and PCi2 and ... through Cable LANi, and each wireless bridge 10-i forms each network segment.

[0017] Drawing 2 shows a format of the MAC frame 100 specified by IEEE802.11 which communicates between wireless bridges in the above-mentioned wireless LAN. The MAC frame 100 consists of the MAC header 110, a body frame 120, and FCS130. The packet which communicates with each cable LAN (network segment), for example, the Ethernet frame, is set to the body frame 120.

[0018] The MAC header 110 consists of the seven fields, the frame control information 111, the period information 112 which shows the duration (duration: Duration/ID) to the completion of transmitting, the address 1:113, the address 2:114, the address 3:115, the sequence control information 116, and the address 4:117.

[0019] Here, the figure shown in the parenthesis shows each field length (the number of octets), and the MAC Address of six octets is set to each address field. High order 3 octet of a MAC Address shows a communication equipment manufacturer the code of a proper, and the three remaining octets serve as a value of a proper at each communication equipment or an interface.

[0020] The contents of the address set as address fields 113, 114, 115, and 117 change with combination of the To DS bit contained in the frame control information 111, and a From DS bit. Here, DS is the cable address of Distribution System and means a connection with LANs other than IEEE802.11, for example, a connection interface with Cable LAN.

[0021] When relaying the packet between Cables LAN, on the wireless bridge 10 As shown to the column of To DS bit = "1" and From DS bit = "1" in the attached table of drawing 3 an address field 114 -- transmitting [in the wireless section] former (agency acting as intermediary) MAC Address: -- TA (transmitter address) -- To an address field 113, destination (junction place) MAC Address RA in the wireless section (receiver address), MAC Address DA (destination address) of the destination terminal of a packet is set to MAC Address SA (source address) of the transmitting agency terminal of a packet, and an address field 115 by the address field 117.

[0022] On each wireless bridge, the MAC Address of each logical port, a corresponding connection wireless bridge, and a terminal can be known by referring to TA address and SA address of a MAC header which were given to the receive packet from the wireless interface.

[0023] Drawing 3 shows a format of the BPDU (bridge protocol data unit) frame transmitted and received between wireless bridges, in order to recognize a network topology. The BPDU frame serves as the bridge ID 207, a port ID 208 and the message age 209, the MAX age 210, and the halo time 211 from the forward delay 212. [a protocol ID 201, the protocol version ID 202 and the BPDU type 203, a flag 204 the root ID 205 and the root run cost 206,]

[0024] In STP, in a network, the wireless bridge where the value of a bridge priority is the lowest turns into a root bridge, and the above-mentioned BPDU frame is transmitted from each port of

a root bridge. Each bridge connected to the above-mentioned root bridge adds the path cost of the root port of a self-bridge to the root run cost 206 of the received BPDU frame, and relays a receiving BPDU frame to other bridges. Each bridge judges the optimal path to a root bridge by referring to the root run cost 206 of the BPDU frame received from each port of a self-bridge. Moreover, when there is a redundancy path, an efficient path is set up by blocking the large port of a path cost.

[0025] Drawing 4 shows one example of the wireless bridge 10 by this invention. The wireless bridge 10 consists of the wireless transceiver circuit 11, the strange demodulator circuit 12, the MAC control section 13, the cable LAN interface 14 connected to the network segment in a bridge, a processor 15, I/O device 16 used as a user interface, memory 17 for program storing, and memory for data storage.

[0026] The transmitting buffer area 18, the receiving buffer area 19, routing table 20, a parameter table 30, an address table 40, and the connection table 50 are formed in the memory for data storage. Moreover, the bridge protocol manipulation routine 62, the network configuration control routine 63, the transmitting manipulation routine 64, and the reception routine 65 are prepared for the memory 17 for program storing as main programs related to this invention besides OS61.

[0027] It connects with the strange demodulator circuit 12, the MAC control section 13, and the cable LAN interface 14 through an internal bus 69, and a processor 15 controls a transfer of the packet between the above-mentioned MAC control section 13 and the cable LAN interface 14 by performing the bridge protocol manipulation routine 62, the transmitting manipulation routine 64, and the reception routine 65 to mention later. Moreover, by performing the network configuration control routine 63, a processor 15 cooperates with the above-mentioned MAC control section 13, performs collection of network configuration information, and renewal of table information, and realizes functions, such as routing in a wireless bridge, network-out-of-order detection, and a setup of a detour.

[0028] Drawing 5 shows the configuration of routing table 20. Routing table 20 shows the correspondence relation between the port number 21 of the input/output port with which each wireless bridge is equipped, and a bridge ID 22 and a destination address (terminal address), and the address (destination address) 23 of ID22 of a connection bridge and two or more terminals which form a network segment on this connection bridge is memorized corresponding to each port number 21.

[0029] The logical port number to which the port number 21 was assigned corresponding to the connection bridge about the circuit system which consists of the wireless interface 11, i.e., a wireless transceiver circuit, a strange demodulator circuit 12, and the MAC processing section 13, and the logical port number assigned to the broadcasts (broadcasting/multicast) mentioned later are contained. Moreover, a meaningless value is set to the port number for broadcasts, and the corresponding connection bridge ID 22, and the address broadcasting / for multicasts is set to a destination address 23.

[0030] Drawing 6 shows the configuration of a parameter table 30. A parameter table 30 consists of the port number 21 registered into the above-mentioned routing table 20, two or more corresponding sub tables 30-1 - 30-m. Bridge ID:34, connection bridge ID:35, and the root run cost 36 are remembered to be a port ID 31, the status 32, and a path cost 33 a root side as parameter information by each sub table 30-i.

[0031] A port ID 31 is ID for identifying the port in the wireless bridge 10, and contains two or more logical port ID (logical port number) assigned to the wireless interface other than the real port ID (port number) assigned to the cable LAN interface 14.

[0032] The status 32 shows the current condition of each port by four condition codes, Listening, Learning, Forwarding, and Blocking. Listening shows the condition that the bridge has transmitted and received BPDU, in order to set a network topology and the optimal pass. When it is in a Listening condition and the high pass of a priority is found rather than the port, it changes in the Blocking condition and the data transfer from the port is blocked. When the high pass of a priority is not found in the state of [port / the] Listening, it changes in the Learning condition and pass information is registered into Forwarding Table. If it is decided beforehand and time

amount (Forward Delay Time) passes in the state of Learning, it will change to Forwarding and the usual data transfer will be performed in the port.
[0033] The path cost 33 expresses the transmission speed of the interface connected to the port, and, generally, in the interface with a earlier transmission speed, the value of a path cost is small. For example, in IEEE802.1D, it is recommended that interface speed sets the path cost of "100" and 100 Mb/s to "19" for the path cost of 10 Mb/s.
[0034] The value of the bridge ID set up as the root side bridge ID 34 and a connection bridge ID 35 is what doubled the bridge priority and the bridge MAC Address. All over a network, the bridge where the above-mentioned bridge priority serves as the minimum value turns into a root bridge. It sees in the root side bridge ID 34 from the port, ID of the bridge which adjoins a root side on a network topology is set to it, and ID of the bridge actually connected to the port or ID of the wireless bridge of the circumference matched with the logical port is set to the connection bridge ID 35. The root run cost 36 shows the total value of the path cost from a root bridge to the port, and the value becomes clear from the BPDU frame mentioned above.
[0035] The table for the addresses (henceforth the self-address) assigned to the wireless bridge and the address table for broadcasts are registered into the address table 40. Drawing 7 shows the address table 41 for broadcasts. Corresponding to label 41A which shows distinction of broadcasting and a multicast, value 41B of the multiple address MAC Address which becomes effective on the bridge is registered into the address table 41 for broadcasts.
[0036] Each wireless bridge 10 compares with the registration address of the above-mentioned address table 40 the junction place address RA in the MAC frame received from the wireless interface by the reception routine 65 mentioned later. When the junction place address RA is in agreement with the self-address or which the address for broadcasts, a receiving frame is passed to the bridge protocol processing section 62, and transfer processing is carried out in a destination address and the corresponding port. Moreover, after collating the destination address with the address for the multiple addresses registered into the address table 41 for the above-mentioned broadcasts and checking the address about the packet which the bridge protocol processing section 62 outputted to the logical port for broadcasts so that it may mention later, the MAC header for the multiple addresses is given, and it is transmitted to a wireless interface.
[0037] Drawing 8 shows the configuration of the connection table 50. The connection table 50 is for specifying other wireless bridges (connection bridge) which should communicate through a wireless interface, and the receiving level 52 of a signal and the flag information 53 which shows the propriety of connection are memorized corresponding to MAC Address 51 of other wireless bridges located in the range which can be transmitted and received.
[0038] In this invention, on each wireless bridge 10, it is judged as the wireless bridge which can connect only the wireless bridge beyond the threshold the receiving level of a signal was beforehand decided to be among other wireless bridges located on the outskirts, these wireless bridges are selected to the object bridge of STP, and assignment of a logical port number and generation of the sub table 30 for parameters are performed.
[0039] That is, in this invention, when each wireless bridge is initialized, a surrounding wireless bridge is scanned and the wireless bridge which can communicate is detected. A probe frame transmits from the wireless bridge side initialized with the passive scan which detects the wireless bridge which can communicate, the probe response frame returned from each surrounding wireless bridge receives, and there is an active scan which detects the wireless bridge which can communicate by carrying out the fixed time-amount monitor of the beacon frame which each surrounding wireless bridge generates as the scanning approach of a wireless bridge of being located on the outskirts, for example.
[0040] When an active scan is adopted, after being received in the wireless transceiver circuit 11 shown in drawing 4 and getting over in the strange demodulator circuit 12, the radio signal of the probe response frame transmitted from other surrounding wireless bridges is inputted into the MAC control section 13 as a MAC frame, and is notified to a processor 15. Moreover, the receiving level of the above-mentioned radio signal is measured in the strange demodulator circuit 12, and is notified to a processor 15 through the MAC control section 23. It can notify the beacon frame received with the passive scan to a processor 15 through the MAC control section

23 about the receiving level of the radio signal measured in the strange demodulator circuit 12 as well as the above. However, you may make it crowded [from the strange demodulator circuit 12 / in a processor 15 / direct picking] about receiving level.
[0041] By performing the network configuration control routine 63 at the time of initialization, a processor 15 analyzes the scanning result of a circumference wireless bridge, and generates the connection table 50 showing the relation between the MAC Address of a circumference wireless bridge, and receiving level.
[0042] By the network configuration control routine 63, the entry registered into the above-mentioned connection table 50 is sorted in order with high receiving level, and the flag information 53 is set as a connectable condition about what has the receiving level higher than the threshold level set up beforehand among surrounding wireless bridges. About the wireless bridge where receiving level is lower than threshold level, it considers as the outside of the object of STP by setting the flag information 53 as the condition of connection no. In this case, the upper limit is set as the number of a connectable wireless bridge in order to control generating of a needlessness truck hook, and you may make it receiving level choose the wireless bridge of the number where receiving level was limited to high order from the wireless bridges more than threshold level.
[0043] As a MAC control section 13, wireless LAN media access controller:HFA3841 of Intersil is used for the scanning data of the circumference wireless bridge mentioned above, and they can collect them by ordering the MAC control section 13 from a processor 15. Moreover, dynamic modification of a network topology can be suited by collecting periodically not only the time of initialization but scanning data.
[0044] In this invention, each wireless bridge uses as a connection bridge the specific wireless bridge chosen by the receiving level mentioned above, assignment of logical port ID and the sub table for parameters are generated, and configuration control, such as routing, is performed.
[0045] In the wireless LAN shown in drawing 1 for example, the wireless bridge 10-1 The wireless bridge 10-2 and 10-3 are chosen as a connection bridge. The wireless bridge 10-2 The wireless bridge 10-1, 10-3, 10-4, and the wireless bridge 10-3 The wireless bridge 10-1, 10-2, 10-4, 01-5, and the wireless bridge 10-4 assume that the wireless bridge 10-2, 10-3, 10-5, and the wireless bridge 10-5 chose the wireless bridge 10-3 and 10-4, respectively. Moreover, the wireless bridge 10-1 turns into a root bridge from the priority of each bridge, and when it is assumed that it is a thing with a path cost with two or more logical ports same in each bridge, the wireless LAN of drawing 1 and corresponding STP topology become like drawing 9 .
[0046] According to the protocol processing facility of STP, each wireless bridge 10-i (i=1-5) estimates the root run cost of each logical port in a self-bridge, and redundancy pass is blocked by it. The logical port connected to the pass P5 between this result 10-2, for example, a bridge, and 10-3 and the pass P8 between a bridge 10-4 and 10-5 is blocked, and it is reflected in a parameter table.
[0047] Moreover, since root run cost becomes the same, the pass P4 between a bridge 10-2 and 10-4 and the pass P6 between a bridge 10-3 and 10-4 choose the port of the younger one as a forwarding port in order of the order of connection bridge ID, and port ID on the bridge 10-4 connected to these pass. For example, when ID of a bridge 10-3 has turned into ID younger than ID of a bridge 10-2, the connection port of pass P4 is blocked.
[0048] However, it may be better to have left pass P4 and to block pass P6 on a bridge 10-4, when the load balance of the whole system is considered. What is necessary is just to adopt the value which amended the path cost of a physical wireless interface with the number of the logical port corresponding to the physical wireless interface as a path cost of each logical port in such a case, for example, each wireless bridge.
[0049] For example, on a bridge 10-2, since three logical ports correspond, one wireless interface sets the path cost of each logical port as 100, and on the other hand, since four logical ports support one wireless interface, the path cost of a logical port is set on a bridge 10-3 to a value higher than a bridge 10-2, 150 [for example,]. If it does in this way, since the root run cost of pass P4 will become smaller than the root run cost of pass P6, pass P4 is made to choose it as a bridge 10-4, and it becomes possible to make pass P6 block.

[0050] In addition, if logical port ID is set as order with the high receiving level from a connection wireless bridge, when two or more pass with the same path cost exists, by choosing the younger one of Port ID, it will leave the pass which was excellent in the circuit condition as a forwarding port, and it will become possible to block the bad pass of a circuit condition automatically.
[0051] Hereafter, with reference to drawing 10 and drawing 11 , the packet transfer operation in the wireless bridge 10 of this invention is explained. Drawing 10 shows the relation of the bridge protocol manipulation routine 62 shown in drawing 3 , the transmitting buffer area 18, the receiving buffer area 19, the transmitting manipulation routine 64, the reception routine 65, and tables 20-40.
[0052] Corresponding to each port, transmission buffer 18-m/receive buffer 19-m the transmission buffer 18-0/receive buffer 19-0 for port 0 - for port m are formed in the transmitting buffer area 18 and the receiving buffer area 19. Although a port number 0 is assigned to the cable LAN interface 14, the logical port number 1 is assigned to broadcasts (broadcasting/multicast) and the logical port number 2 - m are assigned to the communication link with other wireless bridges connected through a wireless interface in this example in order to make easy assignment of the logical port number to a connection bridge, there is especially no constraint in the quota sequence of a port number.
[0053] Only a transmission buffer is required for broadcasts (broadcasting/multicast), and the receive buffer of a port number 1 is omitted by a diagram. Moreover, on account of the drawing notation, the transceiver manipulation routines 64 and 65 are divided into the transceiver manipulation routines 64A and 65A for Cables LAN, and the transceiver manipulation routines 64B and 65B for wireless interfaces (MAC processing section 13), and drawing 10 has shown.
[0054] The bridge protocol manipulation routine (henceforth the bridge protocol processing section) 62 is equipped with the function of STP specified by IEEE802.1D, learns the MAC Address of the packet received through the cable LAN interface 14 and the wireless interface (MAC control section) 13, and memorizes the relation between the port number of each interface, the connection bridge ID, and the transmitting agency address of a receive packet to routing table 20. Moreover, according to routing by STP, the contents of the parameter table 30 according to port are updated suitably.
[0055] As the packet received from the cable LAN interface 14 is stored in the receive buffer 19-0 of the cable LAN interface 14 and the corresponding port number 0 by reception routine 65A and is shown with a signal line 650 by it, the receiving event which showed the above-mentioned port number 0 to the bridge protocol processing section 62 from reception routine 65A is published.
[0056] Answering the above-mentioned receiving event, the bridge protocol processing section 62 searches port number j which corresponds a receive packet with the destination address of routing table 20 to read-out and the above-mentioned receive packet from the receive buffer 19-0 of the port number 0 specified by a receiving event. A receive packet is discarded if the port number corresponding to routing table 20 is not registered with the destination address of a receive packet.
[0057] If a destination address and corresponding port number j become clear, the bridge protocol processing section 62 will publish the transmitting event which shows port number j to transmitting manipulation-routine 64B, as a signal line 640 shows, after storing a receive packet in transmission buffer 18-j which it port-number j Has as a transmitting packet. When a receive packet is a multiple address packet, it is stored in the transmission buffer 18-1 for broadcasts, and the transmitting event which shows a port number 1 is published.
[0058] On the other hand, if the MAC frame shown in drawing 2 from the wireless interface (MAC control section 13) is received, reception routine 65B will collate the junction place address RA (Receiver Address) which the MAC header of a receiving frame shows, and the self-bridge address 42 registered into the address table 40. When RA and the self-bridge address are in agreement, reception routine 65B Sub table 30-k which has the connection bridge ID 35 which was in agreement with the acting as intermediary agency address TA of the above-mentioned MAC header (Transmitter Address) from a parameter table 30 is searched. After storing in receive buffer 19-k with port number k as which the port ID 31 of the above-mentioned sub

table 30-k specifies the packet extracted from the body frame field 120 of a receiving frame, The receiving event which shows the above-mentioned port number k is published to the bridge protocol processing section 62.

[0059] When the junction place address RA of a receiving frame is not in agreement with the self-bridge address, reception routine 65B collates Above RA with the MAC Address for broadcasts registered into the table 41. When in agreement with which the multiple address address with which RA was registered Reception routine 65B like the receiving frame addressed to a self-bridge mentioned above Sub table 30-k which has the connection bridge ID 35 which was in agreement with the acting as intermediary agency address TA from a parameter table 30 is searched. After storing in receive buffer 19-k with port number k as which the port ID 31 of the above-mentioned sub table 30-k specifies the packet extracted from the receiving frame, the receiving event which shows the above-mentioned port number k is published to the bridge protocol processing section 62.

[0060] In the case of an inequality, a receiving frame is discarded by both the self-bridge address with which RA of a receiving frame was registered into the address table 40, and the MAC Address for broadcasts.

[0061] The bridge protocol processing section 62 performs the processing same about the receive packet stored in the receive buffer of the above-mentioned port number k as the receive packet of the port number 0 mentioned above. The junction place address RA is stored in the transmission buffer 18-0 in which the receive packet addressed to a self-bridge and the receive packet for broadcasts have the port number 0 for cable LAN interfaces by this, and the transmitting event which shows the above-mentioned port number 0 to transmitting manipulation-routine 64B is published. Moreover, about the packet for broadcasts taken out from receive buffer 19-i (i=2-m), it becomes possible by storing the copy also in a transmission buffer 18-1 to make the wireless bridge of further others spread.

[0062] Drawing 11 shows the flow chart of the transmitting manipulation routine 64 (64A, 64B) which answers the transmitting event which the above-mentioned bridge protocol processing section 62 publishes, and is performed. In the transmitting manipulation routine 64, a transmitting packet is read from transmission buffer 18-i with port number i specified in the transmitting event (step 641). When port number i specified in the transmitting event is the port number (= 1) of broadcast, the destination address of (step 642) and a transmitting packet (for example, the Ethernet frame) is collated with the MAC Address the object for broadcasting registered into the address table 41 for broadcasts, and for multicasts (step 643), and in the case of an inequality, transmitting processing is ended, without doing anything (a packet being discarded).

[0063] When a destination address is in agreement with which MAC Address for the object for broadcasting, or multicasts, the MAC frame which includes the above-mentioned destination address, i.e., the address broadcasting / for multicasts, in the DA address field 115 and the RA address field 113 of the MAC header 110 is created (step 644), this MAC frame is sent out to the MAC control section 13 (step 645), and transmitting processing is ended. In this case, the self-bridge address is set to the TA address field 114 of a MAC header, and the value of SA address given to the transmitting packet is set to the SA address field 117.

[0064] In the case of which port number for wireless interfaces (=2-m) (step 646), port number i specified in the above-mentioned transmitting event creates the MAC frame which set the MAC Address which the connection bridge ID 35 shows in the above-mentioned port number i and corresponding sub table 30-i as the RA address field 113 (step 647), sends out this MAC frame to the MAC control section 13 (step 645), and ends transmitting processing. In this case, the value of DA address of a transmitting packet is set to the DA address field 115 of a MAC header, and the same value as the MAC header for the above-mentioned broadcasts is set to it by the TA address field 114 and the SA address field 117.

[0065] When port number i specified in the transmitting event does not correspond to the logical port number for broadcasts (= 1), and any of other logical port numbers for wireless interfaces (=2-m) (in the case [This example] of the port number 0 for cable LAN interfaces), a transmitting frame is sent out to the cable LAN interface 14 (step 649), and transmitting processing is ended.

[0066] On the wireless bridge of this invention, what communication link quality was guaranteed to among other wireless bridges located on the outskirts is chosen as a connection bridge, a logical port number is assigned for these connection bridges as an object bridge of STP, and the parameter table for STP transfer control is generated so that clearly from the above example. Moreover, the logical port number of dedication is assigned to broadcast (broadcasting/multicast), and it is made to carry out transmitting processing through the above-mentioned exclusive port about the packet broadcasting / for multicasts. Therefore, there are few communication link errors in the wireless section, and since the packet for broadcasts can be transmitted by one transmitting processing to two or more connection bridges, the transfer efficiency of the message (packet) in the bridge protocol processing section and the wireless section is sharply improvable according to this example.

[0067] In addition, although transmission buffer 18-i of dedication was prepared in the example of drawing 10 corresponding to each port number i Since the transmitting event which shows a transmitting packet and a port number makes a pair and is outputted from the bridge protocol processing section 62, it sets to actual application. What is necessary is to summarize the transmission buffer 18-0 shown in drawing 10 - 18-m at one transmitting packet queue, and just to make it the transmitting manipulation routine 64 repeat read-out of the transmitting event from a transmitting event queue, and read-out of the transmitting packet from the above-mentioned transmitting packet queue by turns.

[0068] What is necessary is to summarize the receive buffer 19-0, and 19-2 - 19-m which also showed drawing 10 at one receive-packet queue, and just to make it the bridge protocol processing section 62 repeat read-out of the receiving event from a receiving event queue, and read-out of the receive packet from the above-mentioned receive-packet queue by turns, since similarly the receiving event which shows a receive packet and a port number makes a pair and is outputted also from the reception routine 65.

[0069] moreover, the thing for which this invention can be applied also when each wireless bridge is equipped with two or more wireless interfaces twisted for example, to frequency multiplex, although the example described the wireless bridge equipped with a wireless interface and every one cable LAN interface, respectively -- it is clear.

[0070] Although the network segment by Cable LAN is formed for every wireless bridge in the example, it is good also as a system configuration which at least one of network segments becomes from two or more wireless terminals which communicate by the wireless bridge and wireless. Moreover, although the example explained the case where protocol processing of 802.1D was performed, in the wireless LAN of IEEE802.11, this invention is applicable to other protocols other than an example.

[0071]

[Effect of the Invention] Since according to this invention a connection bridge is chosen and wireless LAN is constituted according to communication link quality, the unnecessary traffic by poor communication link can be inhibited. Moreover, since the packet for broadcasts can be transmitted by one transmitting processing to two or more connection bridges, the transfer efficiency of the message (packet) in the bridge protocol processing section and the wireless section is sharply improvable.

[Translation done.]

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the wireless bridge for performing individual communication link and broadcast alternatively among other surrounding wireless bridges in more detail about the wireless bridge for combining between two or more network segments by the radio channel.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] Between two or more network segments which consist of cables LAN is connected by the radio channel, the packet generated in each segment is changed into the packet for wireless, and the wireless bridge is known as equipment for transmitting to other network segments. Moreover, the spanning tree protocol (Spanning Tree Protocol:STP) specified by IEEE802.1D is known as a communications protocol between the bridges in Cable LAN.
[0003] In STP, a network configuration (network topology) is recognized by transmitting and receiving the BPDU (bridge protocol data unit) frame with each input/output port of a bridge, and collecting the path cost information which expresses the path rate from the identification information and the root bridge of a connection place bridge for every port. When the loop-formation path exists all over a network, any on a loop-formation path or the network of the arborescence which made the root bridge top-most vertices when a bridge blocked the high pass of a path cost is constituted. The redundancy pass excepted from the network is built into a network as a detour of failure pass, when it becomes impossible to use a main path. In addition, on the bridge equipped with the STP function, each receive packet can be transmitted now to a destination address and the suitable corresponding network segment by learning the MAC Address of the receive packet in each port.
[0004] The protocol processing section of STP is controlling the packet transfer by the conventional bridge equipped with the STP function mentioned above per port, and the destination output port of a receive packet is determined as each port on it on the assumption that the specific network segment is connected, respectively.
[0005] being appropriate -- it is alike and can communicate with two or more surrounding wireless bridges with one wireless interface on a wireless bridge. In IEEE802.11, the access control of the wireless section is performed by CSMS/CA (Carrier sense multiple access with collision avoidance), and when transmitting data to the wireless section, each wireless bridge can be made to carry out the multi-access of the wireless circuit by specifying the MAC Address of the radio station which serves as a junction place by the header unit of a transmitting packet. That is, since one wireless interface corresponds with two or more radio stations physically, even if it is going to perform routing between a self-bridge and other wireless bridges in the protocol processing section of the conventional STP, application of STP of 1 network segment / 1 port becomes difficult.
[0006] For this reason, about a wireless interface, different port management from the LAN interface of a cable in which each has a specific destination bridge is needed. Identifying a logical port is proposed about this point by assigning a logical port for every communications partner of a wireless interface on the wireless bridge which mounted STP in 63rd page - 68 pages of the **** technique RCS 99-24 (1999-05), and checking TA (Transmitter Address) contained in a frame header about the receiving frame from a wireless interface.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention a connection bridge is chosen and wireless LAN is constituted according to communication link quality, the unnecessary traffic by poor communication link can be inhibited. Moreover, since the packet for broadcasts can be transmitted by one transmitting processing to two or more connection bridges, the transfer efficiency of the message (packet) in the bridge protocol processing section and the wireless section is sharply improvable.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As the above-mentioned reference shows, taking advantage of the function of the protocol processing section of the conventional STP, two or more wireless bridges which are different with one wireless interface, and an alternative communication link are attained by assigning a logical port for every communications partner of a wireless interface.
[0008] The packet communication in wireless space adds a MAC header, the packet frame, for example, Ethernet frame, on the cable LAN which forms each network segment, and is performed in the format of specifying a junction place bridge within a MAC header. Therefore, on a wireless bridge, the transmitting packet which was able to be distributed to each logical port by the protocol processing section of STP is changed into the MAC frame which specified the junction place bridge of a proper for every logical port, and is transmitted to other wireless bridges through a wireless interface. Moreover, if a packet is received from a wireless interface, each wireless bridge judges the junction place bridge address, if it is addressing to a self-bridge, will carry out reception and will perform transfer control in a bridge by the protocol processing section of STP.
[0009] Therefore, when performing broadcast which transmits the packet of the same contents to two or more terminals at coincidence like broadcasting or a multicast, according to the Prior art The protocol processing section of STP transmits the copy of the same packet to two or more logical ports for wireless interfaces. Two or more MAC frames which gave the different junction place address for every logical port are transmitted from a wireless interface. Each wireless bridge of a junction place will carry out reception of the MAC frame addressed to itself, and will transmit the multiple address packet of the origin extracted from the receiving MAC frame to each LAN segment. In this case, the problem referred to as causing the increment in the traffic in the wireless section and decline in the transfer efficiency of the message in each wireless bridge from the wireless bridge which became the agency acting as intermediary since two or more MAC frames which changed the junction place address are transmitted repeatedly occurs.
[0010] Moreover, in the wireless section, communication link quality is changed by environmental change. For this reason, on each wireless bridge, when the logical port mentioned above is beforehand assigned fixed corresponding to two or more wireless bridges of the circumference located within limits which can communicate, a message retransmission demand occurs frequently with generating of the reception error by degradation of communication link quality, and the problem referred to as causing the increment in traffic and the decline in the transfer efficiency of a message in the wireless section also has this.
[0011] The purpose of this invention is to offer the wireless bridge excellent in the transfer efficiency of the message in the wireless section. Other purposes of this invention are to offer the wireless bridge which can assign the logical port to a wireless interface appropriately. Especially the purpose of further others of this invention is to offer the wireless bridge which can transmit multiple address packets, such as broadcasting and a multicast, efficiently.

[Translation done.]

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MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the wireless bridge of this invention Communication link quality makes thing selection more than predetermined level out of other wireless bridges located in grasp. It considers as the connection bridge set as the application object of a spanning tree protocol (STP), And two or more wireless bridges are received at broadcasting or the packet which should be carried out a multicast. The MAC header which made broadcasting or a multicast address the junction place address is given, and it is characterized by sending out as a multiple address packet from a wireless interface.
[0013] If it explains in full detail, furthermore, the wireless bridge by this invention The means for choosing the bridge which should be connected according to communication link quality from other wireless bridges which are located on the outskirts and which can be communicated, and giving a logical port identifier to each connection bridge, the port number assigned to the network segments in a bridge, and the above -- with two or more **/receive buffers which were prepared corresponding to the logical port identifier Between the transfer control means which transmits the packet stored in each above-mentioned receive buffer to which transmission buffer specified by the destination address, and other network segments It is characterized by having a means for transmitting and receiving a packet through **/receive buffer, and the above-mentioned wireless interface of one of the above.
[0014] One description of this invention is by preparing a specific logical port identifier and the corresponding transmission buffer for broadcasts to transmit the packet for the object for broadcasting, or multicasts to two or more connection bridges at coincidence.
[0015]
[Embodiment of the Invention] Hereafter, the case where the wireless bridge of this invention is applied to the wireless LAN of IEEE802.11 specification is explained. IEEE802.11 is the specification about the physical layer and MAC (Media Access Control) layer of wireless LAN, and the MAC layer corresponds with the lower layer of the data link layer in an OSI reference model.
[0016] Drawing 1 shows one example of the wireless LAN to which the wireless bridge of this invention is applied. Wireless LAN consists of two or more wireless bridge 10-i (i=1-5), it connects with two or more terminals PCi1 and PCi2 and ... through Cable LANi, and each wireless bridge 10-i forms each network segment.
[0017] Drawing 2 shows a format of the MAC frame 100 specified by IEEE802.11 which communicates between wireless bridges in the above-mentioned wireless LAN. The MAC frame 100 consists of the MAC header 110, a body frame 120, and FCS130. The packet which communicates with each cable LAN (network segment), for example, the Ethernet frame, is set to the body frame 120.
[0018] The MAC header 110 consists of the seven fields, the frame control information 111, the period information 112 which shows the duration (duration: Duration/ID) to the completion of transmitting, the address 1:113, the address 2:114, the address 3:115, the sequence control information 116, and the address 4:117.
[0019] Here, the figure shown in the parenthesis shows each field length (the number of octets), and the MAC Address of six octets is set to each address field. High order 3 octet of a MAC

Address shows a communication equipment manufacturer the code of a proper, and the three remaining octets serve as a value of a proper at each communication equipment or an interface.
[0020] The contents of the address set as address fields 113, 114, 115, and 117 change with combination of the To DS bit contained in the frame control information 111, and a From DS bit. Here, DS is the cable address of Distribution System and means a connection with LANs other than IEEE802.11, for example, a connection interface with Cable LAN.
[0021] When relaying the packet between Cables LAN, on the wireless bridge 10 As shown to the column of To DS bit = "1" and From DS bit = "1" in the attached table of drawing 3 an address field 114 -- transmitting [in the wireless section] former (agency acting as intermediary) MAC Address: -- TA (transmitter address) -- To an address field 113, destination (junction place) MAC Address RA in the wireless section (receiver address), MAC Address DA (destination address) of the destination terminal of a packet is set to MAC Address SA (source address) of the transmitting agency terminal of a packet, and an address field 115 by the address field 117.
[0022] On each wireless bridge, the MAC Address of each logical port, a corresponding connection wireless bridge, and a terminal can be known by referring to TA address and SA address of a MAC header which were given to the receive packet from the wireless interface.
[0023] Drawing 3 shows a format of the BPDU (bridge protocol data unit) frame transmitted and received between wireless bridges, in order to recognize a network topology. The BPDU frame serves as the bridge ID 207, a port ID 208 and the message age 209, the MAX age 210, and the halo time 211 from the forward delay 212. [a protocol ID 201, the protocol version ID 202 and the BPDU type 203, a flag 204 the root ID 205 and the root run cost 206,]
[0024] In STP, in a network, the wireless bridge where the value of a bridge priority is the lowest turns into a root bridge, and the above-mentioned BPDU frame is transmitted from each port of a root bridge. Each bridge connected to the above-mentioned root bridge adds the path cost of the root port of a self-bridge to the root run cost 206 of the received BPDU frame, and relays a receiving BPDU frame to other bridges. Each bridge judges the optimal path to a root bridge by referring to the root run cost 206 of the BPDU frame received from each port of a self-bridge. Moreover, when there is a redundancy path, an efficient path is set up by blocking the large port of a path cost.
[0025] Drawing 4 shows one example of the wireless bridge 10 by this invention. The wireless bridge 10 consists of the wireless transceiver circuit 11, the strange demodulator circuit 12, the MAC control section 13, the cable LAN interface 14 connected to the network segment in a bridge, a processor 15, I/O device 16 used as a user interface, memory 17 for program storing, and memory for data storage.
[0026] The transmitting buffer area 18, the receiving buffer area 19, routing table 20, a parameter table 30, an address table 40, and the connection table 50 are formed in the memory for data storage. Moreover, the bridge protocol manipulation routine 62, the network configuration control routine 63, the transmitting manipulation routine 64, and the reception routine 65 are prepared for the memory 17 for program storing as main programs related to this invention besides OS61.
[0027] It connects with the strange demodulator circuit 12, the MAC control section 13, and the cable LAN interface 14 through an internal bus 69, and a processor 15 controls a transfer of the packet between the above-mentioned MAC control section 13 and the cable LAN interface 14 by performing the bridge protocol manipulation routine 62, the transmitting manipulation routine 64, and the reception routine 65 to mention later. Moreover, by performing the network configuration control routine 63, a processor 15 cooperates with the above-mentioned MAC control section 13, performs collection of network configuration information, and renewal of table information, and realizes functions, such as routing in a wireless bridge, network-out-of-order detection, and a setup of a detour.
[0028] Drawing 5 shows the configuration of routing table 20. Routing table 20 shows the correspondence relation between the port number 21 of the input/output port with which each wireless bridge is equipped, and a bridge ID 22 and a destination address (terminal address), and the address (destination address) 23 of ID22 of a connection bridge and two or more terminals

which form a network segment on this connection bridge is memorized corresponding to each port number 21.
[0029] The logical port number to which the port number 21 was assigned corresponding to the connection bridge about the circuit system which consists of the wireless interface 11, i.e., a wireless transceiver circuit, a strange demodulator circuit 12, and the MAC processing section 13, and the logical port number assigned to the broadcasts (broadcasting/multicast) mentioned later are contained. Moreover, a meaningless value is set to the port number for broadcasts, and the corresponding connection bridge ID 22, and the address broadcasting / for multicasts is set to a destination address 23.
[0030] Drawing 6 shows the configuration of a parameter table 30. A parameter table 30 consists of the port number 21 registered into the above-mentioned routing table 20, two or more corresponding sub tables 30-1 - 30-m. Bridge ID:34, connection bridge ID:35, and the root run cost 36 are remembered to be a port ID 31, the status 32, and a path cost 33 a root side as parameter information by each sub table 30-i.
[0031] A port ID 31 is ID for identifying the port in the wireless bridge 10, and contains two or more logical port ID (logical port number) assigned to the wireless interface other than the real port ID (port number) assigned to the cable LAN interface 14.
[0032] The status 32 shows the current condition of each port by four condition codes, Listening, Learning, Forwarding, and Blocking. Listening shows the condition that the bridge has transmitted and received BPDU, in order to set a network topology and the optimal pass. When it is in a Listening condition and the high pass of a priority is found rather than the port, it changes in the Blocking condition and the data transfer from the port is blocked. When the high pass of a priority is not found in the state of [port / the] Listening, it changes in the Learning condition and pass information is registered into Forwarding Table. If it is decided beforehand and time amount (Forward Delay Time) passes in the state of Learning, it will change to Forwarding and the usual data transfer will be performed in the port.
[0033] The path cost 33 expresses the transmission speed of the interface connected to the port, and, generally, in the interface with a earlier transmission speed, the value of a path cost is small. For example, in IEEE802.1D, it is recommended that interface speed sets the path cost of "100" and 100 Mb/s to "19" for the path cost of 10 Mb/s.
[0034] The value of the bridge ID set up as the root side bridge ID 34 and a connection bridge ID 35 is what doubled the bridge priority and the bridge MAC Address. All over a network, the bridge where the above-mentioned bridge priority serves as the minimum value turns into a root bridge. It sees in the root side bridge ID 34 from the port, ID of the bridge which adjoins a root side on a network topology is set to it, and ID of the bridge actually connected to the port or ID of the wireless bridge of the circumference matched with the logical port is set to the connection bridge ID 35. The root run cost 36 shows the total value of the path cost from a root bridge to the port, and the value becomes clear from the BPDU frame mentioned above.
[0035] The table for the addresses (henceforth the self-address) assigned to the wireless bridge and the address table for broadcasts are registered into the address table 40. Drawing 7 shows the address table 41 for broadcasts. Corresponding to label 41A which shows distinction of broadcasting and a multicast, value 41B of the multiple address MAC Address which becomes effective on the bridge is registered into the address table 41 for broadcasts.
[0036] Each wireless bridge 10 compares with the registration address of the above-mentioned address table 40 the junction place address RA in the MAC frame received from the wireless interface by the reception routine 65 mentioned later. When the junction place address RA is in agreement with the self-address or which the address for broadcasts, a receiving frame is passed to the bridge protocol processing section 62, and transfer processing is carried out in a destination address and the corresponding port. Moreover, after collating the destination address with the address for the multiple addresses registered into the address table 41 for the above-mentioned broadcasts and checking the address about the packet which the bridge protocol processing section 62 outputted to the logical port for broadcasts so that it may mention later, the MAC header for the multiple addresses is given, and it is transmitted to a wireless interface.
[0037] Drawing 8 shows the configuration of the connection table 50. The connection table 50 is

for specifying other wireless bridges (connection bridge) which should communicate through a wireless interface, and the receiving level 52 of a signal and the flag information 53 which shows the propriety of connection are memorized corresponding to MAC Address 51 of other wireless bridges located in the range which can be transmitted and received.
[0038] In this invention, on each wireless bridge 10, it is judged as the wireless bridge which can connect only the wireless bridge beyond the threshold the receiving level of a signal was beforehand decided to be among other wireless bridges located on the outskirts, these wireless bridges are selected to the object bridge of STP, and assignment of a logical port number and generation of the sub table 30 for parameters are performed.
[0039] That is, in this invention, when each wireless bridge is initialized, a surrounding wireless bridge is scanned and the wireless bridge which can communicate is detected. A probe frame transmits from the wireless bridge side initialized with the passive scan which detects the wireless bridge which can communicate, the probe response frame returned from each surrounding wireless bridge receives, and there is an active scan which detects the wireless bridge which can communicate by carrying out the fixed time-amount monitor of the beacon frame which each surrounding wireless bridge generates as the scanning approach of a wireless bridge of being located on the outskirts, for example.
[0040] When an active scan is adopted, after being received in the wireless transceiver circuit 11 shown in drawing 4 and getting over in the strange demodulator circuit 12, the radio signal of the probe response frame transmitted from other surrounding wireless bridges is inputted into the MAC control section 13 as a MAC frame, and is notified to a processor 15. Moreover, the receiving level of the above-mentioned radio signal is measured in the strange demodulator circuit 12, and is notified to a processor 15 through the MAC control section 23. It can notify the beacon frame received with the passive scan to a processor 15 through the MAC control section 23 about the receiving level of the radio signal measured in the strange demodulator circuit 12 as well as the above. However, you may make it crowded [from the strange demodulator circuit 12 / in a processor 15 / direct picking] about receiving level.
[0041] By performing the network configuration control routine 63 at the time of initialization, a processor 15 analyzes the scanning result of a circumference wireless bridge, and generates the connection table 50 showing the relation between the MAC Address of a circumference wireless bridge, and receiving level.
[0042] By the network configuration control routine 63, the entry registered into the above-mentioned connection table 50 is sorted in order with high receiving level, and the flag information 53 is set as a connectable condition about what has the receiving level higher than the threshold level set up beforehand among surrounding wireless bridges. About the wireless bridge where receiving level is lower than threshold level, it considers as the outside of the object of STP by setting the flag information 53 as the condition of connection no. In this case, the upper limit is set as the number of a connectable wireless bridge in order to control generating of a needlessness truck hook, and you may make it receiving level choose the wireless bridge of the number where receiving level was limited to high order from the wireless bridges more than threshold level.
[0043] As a MAC control section 13, wireless LAN media access controller:HFA3841 of Intersil is used for the scanning data of the circumference wireless bridge mentioned above, and they can collect them by ordering the MAC control section 13 from a processor 15. Moreover, dynamic modification of a network topology can be suited by collecting periodically not only the time of initialization but scanning data.
[0044] In this invention, each wireless bridge uses as a connection bridge the specific wireless bridge chosen by the receiving level mentioned above, assignment of logical port ID and the sub table for parameters are generated, and configuration control, such as routing, is performed.
[0045] In the wireless LAN shown in drawing 1 for example, the wireless bridge 10-1 The wireless bridge 10-2 and 10-3 are chosen as a connection bridge. The wireless bridge 10-2 The wireless bridge 10-1, 10-3, 10-4, and the wireless bridge 10-3 The wireless bridge 10-1, 10-2, 10-4, 01-5, and the wireless bridge 10-4 assume that the wireless bridge 10-2, 10-3, 10-5, and the wireless bridge 10-5 chose the wireless bridge 10-3 and 10-4, respectively. Moreover, the

wireless bridge 10-1 turns into a root bridge from the priority of each bridge, and when it is assumed that it is a thing with a path cost with two or more logical ports same in each bridge, the wireless LAN of drawing 1 and corresponding STP topology become like drawing 9 .
[0046] According to the protocol processing facility of STP, each wireless bridge 10-i (i=1-5) estimates the root run cost of each logical port in a self-bridge, and redundancy pass is blocked by it. The logical port connected to the pass P5 between this result 10-2, for example, a bridge, and 10-3 and the pass P8 between a bridge 10-4 and 10-5 is blocked, and it is reflected in a parameter table.
[0047] Moreover, since root run cost becomes the same, the pass P4 between a bridge 10-2 and 10-4 and the pass P6 between a bridge 10-3 and 10-4 choose the port of the younger one as a forwarding port in order of the order of connection bridge ID, and port ID on the bridge 10-4 connected to these pass. For example, when ID of a bridge 10-3 has turned into ID younger than ID of a bridge 10-2, the connection port of pass P4 is blocked.
[0048] However, it may be better to have left pass P4 and to block pass P6 on a bridge 10-4, when the load balance of the whole system is considered. What is necessary is just to adopt the value which amended the path cost of a physical wireless interface with the number of the logical port corresponding to the physical wireless interface as a path cost of each logical port in such a case, for example, each wireless bridge.
[0049] For example, on a bridge 10-2, since three logical ports correspond, one wireless interface sets the path cost of each logical port as 100, and on the other hand, since four logical ports support one wireless interface, the path cost of a logical port is set on a bridge 10-3 to a value higher than a bridge 10-2, 150 [for example,]. If it does in this way, since the root run cost of pass P4 will become smaller than the root run cost of pass P6, pass P4 is made to choose it as a bridge 10-4, and it becomes possible to make pass P6 block.
[0050] In addition, if logical port ID is set as order with the high receiving level from a connection wireless bridge, when two or more pass with the same path cost exists, by choosing the younger one of Port ID, it will leave the pass which was excellent in the circuit condition as a forwarding port, and it will become possible to block the bad pass of a circuit condition automatically.
[0051] Hereafter, with reference to drawing 10 and drawing 11 , the packet transfer operation in the wireless bridge 10 of this invention is explained. Drawing 10 shows the relation of the bridge protocol manipulation routine 62 shown in drawing 3 , the transmitting buffer area 18, the receiving buffer area 19, the transmitting manipulation routine 64, the reception routine 65, and tables 20-40.
[0052] Corresponding to each port, transmission buffer 18-m/receive buffer 19-m the transmission buffer 18-0/receive buffer 19-0 for port 0 - for port m are formed in the transmitting buffer area 18 and the receiving buffer area 19. Although a port number 0 is assigned to the cable LAN interface 14, the logical port number 1 is assigned to broadcasts (broadcasting/multicast) and the logical port number 2 - m are assigned to the communication link with other wireless bridges connected through a wireless interface in this example in order to make easy assignment of the logical port number to a connection bridge, there is especially no constraint in the quota sequence of a port number.
[0053] Only a transmission buffer is required for broadcasts (broadcasting/multicast), and the receive buffer of a port number 1 is omitted by a diagram. Moreover, on account of the drawing notation, the transceiver manipulation routines 64 and 65 are divided into the transceiver manipulation routines 64A and 65A for Cables LAN, and the transceiver manipulation routines 64B and 65B for wireless interfaces (MAC processing section 13), and drawing 10 has shown.
[0054] The bridge protocol manipulation routine (henceforth the bridge protocol processing section) 62 is equipped with the function of STP specified by IEEE802.1D, learns the MAC Address of the packet received through the cable LAN interface 14 and the wireless interface (MAC control section) 13, and memorizes the relation between the port number of each interface, the connection bridge ID, and the transmitting agency address of a receive packet to routing table 20. Moreover, according to routing by STP, the contents of the parameter table 30 according to port are updated suitably.
[0055] As the packet received from the cable LAN interface 14 is stored in the receive buffer

19-0 of the cable LAN interface 14 and the corresponding port number 0 by reception routine 65A and is shown with a signal line 650 by it, the receiving event which showed the above-mentioned port number 0 to the bridge protocol processing section 62 from reception routine 65A is published.

[0056] Answering the above-mentioned receiving event, the bridge protocol processing section 62 searches port number j which corresponds a receive packet with the destination address of routing table 20 to read-out and the above-mentioned receive packet from the receive buffer 19-0 of the port number 0 specified by a receiving event. A receive packet is discarded if the port number corresponding to routing table 20 is not registered with the destination address of a receive packet.

[0057] If a destination address and corresponding port number j become clear, the bridge protocol processing section 62 will publish the transmitting event which shows port number j to transmitting manipulation-routine 64B, as a signal line 640 shows, after storing a receive packet in transmission buffer 18-j which it port-number j Has as a transmitting packet. When a receive packet is a multiple address packet, it is stored in the transmission buffer 18-1 for broadcasts, and the transmitting event which shows a port number 1 is published.

[0058] On the other hand, if the MAC frame shown in drawing 2 from the wireless interface (MAC control section 13) is received, reception routine 65B will collate the junction place address RA (Receiver Address) which the MAC header of a receiving frame shows, and the self-bridge address 42 registered into the address table 40. When RA and the self-bridge address are in agreement, reception routine 65B Sub table 30-k which has the connection bridge ID 35 which was in agreement with the acting as intermediary agency address TA of the above-mentioned MAC header (Transmitter Address) from a parameter table 30 is searched. After storing in receive buffer 19-k with port number k as which the port ID 31 of the above-mentioned sub table 30-k specifies the packet extracted from the body frame field 120 of a receiving frame, The receiving event which shows the above-mentioned port number k is published to the bridge protocol processing section 62.

[0059] When the junction place address RA of a receiving frame is not in agreement with the self-bridge address, reception routine 65B collates Above RA with the MAC Address for broadcasts registered into the table 41. When in agreement with which the multiple address address with which RA was registered Reception routine 65B like the receiving frame addressed to a self-bridge mentioned above Sub table 30-k which has the connection bridge ID 35 which was in agreement with the acting as intermediary agency address TA from a parameter table 30 is searched. After storing in receive buffer 19-k with port number k as which the port ID 31 of the above-mentioned sub table 30-k specifies the packet extracted from the receiving frame, the receiving event which shows the above-mentioned port number k is published to the bridge protocol processing section 62.

[0060] In the case of an inequality, a receiving frame is discarded by both the self-bridge address with which RA of a receiving frame was registered into the address table 40, and the MAC Address for broadcasts.

[0061] The bridge protocol processing section 62 performs the processing same about the receive packet stored in the receive buffer of the above-mentioned port number k as the receive packet of the port number 0 mentioned above. The junction place address RA is stored in the transmission buffer 18-0 in which the receive packet addressed to a self-bridge and the receive packet for broadcasts have the port number 0 for cable LAN interfaces by this, and the transmitting event which shows the above-mentioned port number 0 to transmitting manipulation-routine 64B is published. Moreover, about the packet for broadcasts taken out from receive buffer 19-i (i=2-m), it becomes possible by storing the copy also in a transmission buffer 18-1 to make the wireless bridge of further others spread.

[0062] Drawing 11 shows the flow chart of the transmitting manipulation routine 64 (64A, 64B) which answers the transmitting event which the above-mentioned bridge protocol processing section 62 publishes, and is performed. In the transmitting manipulation routine 64, a transmitting packet is read from transmission buffer 18-i with port number i specified in the transmitting event (step 641). When port number i specified in the transmitting event is the port number (= 1)

of broadcast, the destination address of (step 642) and a transmitting packet (for example, the Ethernet frame) is collated with the MAC Address the object for broadcasting registered into the address table 41 for broadcasts, and for multicasts (step 643), and in the case of an inequality, transmitting processing is ended, without doing anything (a packet being discarded).
[0063] When a destination address is in agreement with which MAC Address for the object for broadcasting, or multicasts, the MAC frame which includes the above-mentioned destination address, i.e., the address broadcasting / for multicasts, in the DA address field 115 and the RA address field 113 of the MAC header 110 is created (step 644), this MAC frame is sent out to the MAC control section 13 (step 645), and transmitting processing is ended. In this case, the self-bridge address is set to the TA address field 114 of a MAC header, and the value of SA address given to the transmitting packet is set to the SA address field 117.
[0064] In the case of which port number for wireless interfaces (=2-m) (step 646), port number i specified in the above-mentioned transmitting event creates the MAC frame which set the MAC Address which the connection bridge ID 35 shows in the above-mentioned port number i and corresponding sub table 30-i as the RA address field 113 (step 647), sends out this MAC frame to the MAC control section 13 (step 645), and ends transmitting processing. In this case, the value of DA address of a transmitting packet is set to the DA address field 115 of a MAC header, and the same value as the MAC header for the above-mentioned broadcasts is set to it by the TA address field 114 and the SA address field 117.
[0065] When port number i specified in the transmitting event does not correspond to the logical port number for broadcasts (= 1), and any of other logical port numbers for wireless interfaces (=2-m) (in the case [This example] of the port number 0 for cable LAN interfaces), a transmitting frame is sent out to the cable LAN interface 14 (step 649), and transmitting processing is ended.
[0066] On the wireless bridge of this invention, what communication link quality was guaranteed to among other wireless bridges located on the outskirts is chosen as a connection bridge, a logical port number is assigned for these connection bridges as an object bridge of STP, and the parameter table for STP transfer control is generated so that clearly from the above example. Moreover, the logical port number of dedication is assigned to broadcast (broadcasting/multicast), and it is made to carry out transmitting processing through the above-mentioned exclusive port about the packet broadcasting / for multicasts. Therefore, there are few communication link errors in the wireless section, and since the packet for broadcasts can be transmitted by one transmitting processing to two or more connection bridges, the transfer efficiency of the message (packet) in the bridge protocol processing section and the wireless section is sharply improvable according to this example.
[0067] In addition, although transmission buffer 18-i of dedication was prepared in the example of drawing 10 corresponding to each port number i Since the transmitting event which shows a transmitting packet and a port number makes a pair and is outputted from the bridge protocol processing section 62, it sets to actual application. What is necessary is to summarize the transmission buffer 18-0 shown in drawing 10 - 18-m at one transmitting packet queue, and just to make it the transmitting manipulation routine 64 repeat read-out of the transmitting event from a transmitting event queue, and read-out of the transmitting packet from the above-mentioned transmitting packet queue by turns.
[0068] What is necessary is to summarize the receive buffer 19-0, and 19-2 - 19-m which also showed drawing 10 at one receive-packet queue, and just to make it the bridge protocol processing section 62 repeat read-out of the receiving event from a receiving event queue, and read-out of the receive packet from the above-mentioned receive-packet queue by turns, since similarly the receiving event which shows a receive packet and a port number makes a pair and is outputted also from the reception routine 65.
[0069] moreover, the thing for which this invention can be applied also when each wireless bridge is equipped with two or more wireless interfaces twisted for example, to frequency multiplex, although the example described the wireless bridge equipped with a wireless interface and every one cable LAN interface, respectively -- it is clear.
[0070] Although the network segment by Cable LAN is formed for every wireless bridge in the

example, it is good also as a system configuration which at least one of network segments becomes from two or more wireless terminals which communicate by the wireless bridge and wireless. Moreover, although the example explained the case where protocol processing of 802.1D was performed, in the wireless LAN of IEEE802.11, this invention is applicable to other protocols other than an example.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing showing one example of the wireless LAN to which the wireless bridge of this invention is applied.
[Drawing 2] Drawing showing a format of the MAC frame which communicates between wireless bridges.
[Drawing 3] Drawing showing a format of BPDU (Bridge Protocol Data Unit) transmitted in order to recognize a network topology.
[Drawing 4] Drawing showing one example of the wireless bridge by this invention.
[Drawing 5] Drawing showing the configuration of the routing table 20 contained in drawing 4 .
[Drawing 6] Drawing showing the configuration of the parameter table 30 contained in drawing 4 .

[Drawing 7] Drawing showing the configuration of the address table 41 for broadcasts contained in the address table 40 of drawing 4 .
[Drawing 8] Drawing showing the configuration of the connection table 50 contained in drawing 4 .
[Drawing 9] Drawing showing one example of the wireless LAN of drawing 1 , and corresponding STP topology.
[Drawing 10] Drawing for explaining the transfer operation of the packet in the wireless bridge of this invention.
[Drawing 11] The flow chart which shows the function of the packet transmitting manipulation routine 65.
[Description of Notations]
A 10-1 - 10-5:wireless bridge, PC11-PC5k : A terminal unit, 11: A wireless transceiver circuit, a 12:strange demodulator circuit, a 13:MAC control section, 14 : A cable LAN interface, 15 : A processor, 16:I/O device, 17:program memory, 18:transmission buffer, 19 : A receive buffer, 20:routing table, 30:parameter table, 40: -- an address table, the address table for 41:broadcasts, the 42:self-bridge address, 50:connection table, and 61: -- OS, 62:bridge protocol manipulation routine, 63:network configuration control routine, a 64:transmitting manipulation routine, and 65:reception routine.

[Translation done.]

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[Claim(s)]
[Claim 1]
In the wireless bridge equipped with the wireless interface for transmitting a packet between network segments,
The means for choosing the bridge which should be connected according to communication link quality from other wireless bridges which are located on the outskirts and which can be communicated, and giving a logical port identifier to each connection bridge,
the port number assigned to the network segments in a bridge, and the above -- two or more **/receive buffers which were prepared corresponding to the logical port identifier,
The transfer control means which transmits the packet stored in each above-mentioned receive buffer to which transmission buffer specified by the destination address,
between other network segments -- the above -- the wireless bridge characterized by having a means for transmitting and receiving a packet through which **/receive buffer, and above-mentioned wireless interface.
[Claim 2]

The wireless bridge according to claim 1 characterized by for said grant means choosing the thing beyond the threshold to which signal receiving level was set beforehand as said connection bridge from other wireless bridges located on the outskirts, and giving a port number.
[Claim 3]
The wireless bridge according to claim 1 where said grant means is characterized by choosing said connection bridge within the limits of the upper limit number as which signal receiving level was beforehand specified out of the circumference bridge beyond said threshold.
[Claim 4]
In the wireless bridge which assigns a logical port identifier to the surrounding specific wireless bridge connected through a wireless interface, and controls the packet transfer between network segments by this port identifier,
**/receive buffer prepared corresponding to the port number assigned to the network segments in a bridge,
Two or more **/receive buffers which were prepared corresponding to the logical port identifier assigned to the above-mentioned circumference wireless bridge,
The transmission buffer prepared corresponding to the logical port identifier assigned to broadcasts,
The transfer control means which transmits the packet stored in each above-mentioned receive buffer to which transmission buffer specified by the destination address,
The wireless bridge characterized by having given the port number for the above-mentioned circumference wireless bridges, and the header addressed to a circumference wireless bridge which corresponds to the transmitting packet read from the corresponding transmission buffer, having given the header for broadcasts to the packet read from the port identifier for the above-mentioned broadcasts, and the corresponding transmission buffer, and having a transmitting processing means to send out to the above-mentioned wireless interface.
[Claim 5]
In the wireless bridge which manages a network configuration according to the spanning tree protocol which has a wireless interface and an interface for network segments, carried out packet communication in the MAC frame format of having followed IEEE802.11 in the wireless section, and was specified to IEEE802.1D,
The wireless bridge characterized by having a means for giving the MAC header which contains broadcasting or a multicast address as the junction place address to broadcasting or the packet which should be carried out a multicast on two or more surrounding wireless bridges, and sending out as a multiple address packet from the above-mentioned wireless interface.

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最終頁に続く

(54)【発明の名称】　無線ブリッジ

(57)【要約】
【課題】　メッセージの転送効率に優れた無線ブリッジを提供する。
【解決手段】　通信可能範囲に位置する他の無線ブリッジの中から、通信品質が所定レベル以上のもの選択して、スパニングツリープロトコル（ＳＴＰ）の適用対象とし、複数の無線ブリッジに同報通信すべきパケットに対して、ブロードキャストまたはマルチキャストアドレスを中継先アドレスとしたＭＡＣヘッダを付与し、無線インタフェースから同報パケットとして送出する無線ブリッジ。

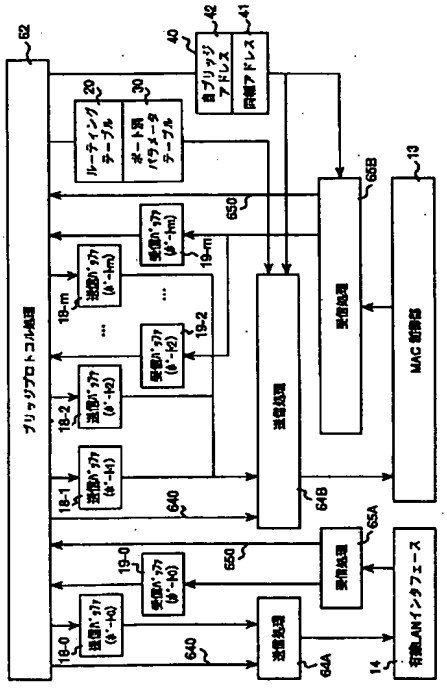


図１０

【特許請求の範囲】
【請求項１】ネットワークセグメント間でパケットを転送するための無線インタフェースを備えた無線ブリッジにおいて、
周辺に位置する通信可能な他の無線ブリッジの中から、通信品質によって接続すべきブリッジを選択し、各接続ブリッジに論理的なポート識別子を付与するための手段と、
ブリッジ内のネットワークセグメント用に割り当てられたポート番号と上記論理的なポート識別子に対応して用意された複数の送／受信バッファと、
上記各受信バッファに格納されたパケットを宛先アドレスによって特定される何れかの送信バッファに転送する転送制御手段と、
他のネットワークセグメントとの間で、上記何れかの送／受信バッファと上記無線インタフェースとを介して、パケットを送受信するための手段とを備えたことを特徴とする無線ブリッジ。
【請求項２】前記付与手段が、周辺に位置する他の無線ブリッジの中から、信号受信レベルが予め設定された閾値以上のものを前記接続ブリッジとして選択し、ポート番号を付与することを特徴とする請求項１に記載の無線ブリッジ。
【請求項３】前記付与手段が、信号受信レベルが前記閾値以上の周辺ブリッジの中から、予め指定された上限個数の範囲内で前記接続ブリッジを選択することを特徴とする請求項１に記載の無線ブリッジ。
【請求項４】特定の論理ポート識別子と対応した同報通信用の送信バッファを用意し、
前記送受信手段が、他のネットワークセグメントに対して、上記同報通信用の送信バッファを利用して、ブロードキャスト用またはマルチキャスト用のパケットを送信することを特徴とする請求項１～請求項３の何れかに記載の無線ブリッジ。
【請求項５】無線インタフェースを介して接続される周辺の特定の無線ブリッジに対して論理的なポート識別子を割り当て、該ポート識別子によってネットワークセグメント間のパケット転送を制御する無線ブリッジにおいて、
ブリッジ内のネットワークセグメント用に割り当てられたポート番号に対応して用意された送／受信バッファと、
上記周辺無線ブリッジ用に割り当てられた論理的なポート識別子に対応して用意された複数の送／受信バッファと、
同報通信用に割り当てられた論理的なポート識別子に対応して用意された送信バッファと、
上記各受信バッファに格納されたパケットを宛先アドレスによって特定される何れかの送信バッファに転送する転送制御手段と、
上記周辺無線ブリッジ用のポート番号と対応する送信バッファから読み出された送信パケットに対して該当する周辺無線ブリッジ宛のヘッダを付与し、上記同報通信用のポート識別子と対応する送信バッファから読み出されたパケットに対して同報通信用のヘッダを付与して、上記無線インタフェースに送出する送信処理手段とを備えたことを特徴とする無線ブリッジ。
【請求項６】前記送信処理手段が、前記送信パケットに対して、前記周辺無線ブリッジのアドレスまたは同報通信用のアドレスを中継先アドレス、自ブリッジアドレスを中継元アドレスとして含むＭＡＣヘッダを付与することを特徴とする請求項５に記載の無線ブリッジ。
【請求項７】同報アドレスを記憶するための記憶手段を有し、
前記送信処理手段が、前記同報通信用のポート識別子と対応する送信バッファから読み出されたパケットの宛先アドレスを上記記憶手段に記憶された同報アドレスと照合し、何れかの同報アドレスに一致した場合に、前記ヘッダの付与と無線インタフェースへの送出を行うことを特徴とする請求項５または請求項６に記載の無線ブリッジ。
【請求項８】自ブリッジアドレスと同報アドレスとを記憶するための記憶手段と、
前記無線インタフェースからの受信パケットを前記周辺無線ブリッジ用のポート識別子と対応する何れかの受信バッファに選択的に格納する受信処理手段を有し、
上記受信処理手段が、受信パケットのヘッダに含まれる中継先アドレスを上記記憶手段に記憶されたアドレスと照合し、上記中継先アドレスが上記自ブリッジアドレスまたは何れかの同報アドレスと一致した受信パケットを該パケットの中継元となった周辺無線ブリッジのポート識別子と対応した受信バッファに格納することを特徴とする請求項５または請求項６に記載の無線ブリッジ。
【請求項９】無線インタフェースとネットワークセグメント用のインタフェースを有し、無線区間では、ＩＥＥＥ８０２．１１に従ったＭＡＣフレーム形式でパケット通信し、ＩＥＥＥ８０２．１Ｄに規定されたスパニングツリープロトコルに従ってネットワークの構成を管理する無線ブリッジにおいて、
周辺の複数の無線ブリッジにブロードキャストまたはマルチキャストすべきパケットに対し、中継先アドレスとしてブロードキャストまたはマルチキャストアドレスを含むＭＡＣヘッダを付与し、上記無線インタフェースから同報パケットとして送出するための手段を備えたことを特徴とする無線ブリッジ。
【請求項１０】前記スパニングツリープロトコルの対象となる接続ブリッジとして、通信可能範囲に位置する他の無線ブリッジの中から、通信品質が所定レベル以上のもの選択するための手段を備えたことを特徴とする請求項９に記載の無線ブリッジ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、複数のネットワークセグメント間を無線チャネルで結合するための無線ブリッジに関し、更に詳しくは、周辺の他の無線ブリッジとの間で個別通信と同報通信を選択的に行うための無線ブリッジに関するものである。

【０００２】

【従来の技術】有線ＬＡＮで構成される複数のネットワークセグメント間を無線チャネルで接続し、各セグメントで発生したパケットを無線用のパケットに変換して、他のネットワークセグメントへ転送するための装置として、無線ブリッジが知られている。また、有線ＬＡＮにおけるブリッジ間の通信プロトコルとして、ＩＥＥＥ８０２．１Ｄで規定されているスパニングツリープロトコル（Spanning Tree Protocol：ＳＴＰ）が知られている。

【０００３】ＳＴＰでは、ブリッジの各入出力ポートでＢＰＤＵ（bridge protocol data unit）フレームを送受信し、ポート毎に接続先ブリッジの識別情報とルートブリッジからの経路速度を表すパスコスト情報とを収集することによって、ネットワークの構成（ネットワークトポロジー）が認識される。ネットワーク中にループ経路が存在していた場合は、ループ経路上の何れかブリッジが、パスコストの高いパスをブロックすることによって、ルートブリッジを頂点とした樹枝状のネットワークが構成される。ネットワークから除外された冗長パスは、メインパスが使用できなくなった時、障害パスの迂回路としてネットワークに組み込まれる。尚、ＳＴＰ機能を備えたブリッジでは、各ポートにおける受信パケットのＭＡＣアドレスを学習することによって、各受信パケットを宛先アドレスと対応した適切なネットワークセグメントに転送できるようになっている。

【０００４】上述したＳＴＰ機能を備えた従来のブリッジでは、ＳＴＰのプロトコル処理部がポート単位でパケット転送を制御しており、各ポートにそれぞれ特定のネットワークセグメントが接続されていることを前提として、受信パケットの転送先出力ポートが決定されている。

【０００５】然るに、無線ブリッジでは、１つの無線インタフェースで周辺の複数の無線ブリッジと交信できる。ＩＥＥＥ８０２．１１では、無線区間のアクセス制御をＣＳＭＳ／ＣＡ（Carrier sense multiple access with collision avoidance）で行っており、無線区間にデータを送信する場合、各無線ブリッジが、送信パケットのヘッダ部で中継先となる無線局のＭＡＣアドレスを指定することによって、無線回線を多重アクセスできるようにしている。つまり、物理的には一つの無線インタフェースが複数の無線局と対応しているため、従来のＳＴＰのプロトコル処理部で自ブリッジと他の無線ブリッジとの間の経路設定を行おうとしても、１ネットワークセグメント／1ポートのＳＴＰの適用が困難となる。

【０００６】このため、無線インタフェースについては、それぞれが特定の転送先ブリッジをもつ有線のＬＡＮインタフェースとは異なったポート管理が必要となる。この点に関し、信学技法ＲＣＳ９９－２４（１９９９－０５）の第６３頁～６８頁には、ＳＴＰを実装した無線ブリッジにおいて、無線インタフェースの通信相手毎に論理的なポートを割り当て、無線インタフェースからの受信フレームについては、フレームヘッダに含まれるＴＡ（Transmitter Address）をチェックすることによって、論理ポートを識別することが提案されている。

【０００７】

【発明が解決しようとする課題】上記文献が示すように、無線インタフェースの通信相手毎に論理的なポートを割り当てることによって、従来のＳＴＰのプロトコル処理部の機能を活かして、１つの無線インタフェースで異なる複数の無線ブリッジと選択的な通信が可能となる。

【０００８】無線空間でのパケット通信は、各ネットワークセグメントを形成する有線ＬＡＮ上のパケットフレーム、例えば、EthernetフレームにＭＡＣヘッダを付加し、ＭＡＣヘッダ内で中継先ブリッジを指定する形式で行われる。従って、無線ブリッジにおいては、ＳＴＰのプロトコル処理部によって各論理ポートに振り分けられた送信パケットが、論理ポート毎に固有の中継先ブリッジを指定したＭＡＣフレームに変換され、無線インタフェースを介して、他の無線ブリッジに転送される。また、各無線ブリッジは、無線インタフェースからパケットを受信すると、中継先ブリッジアドレスを判定し、自ブリッジ宛であれば受信処理し、ＳＴＰのプロトコル処理部によってブリッジ内での転送制御を行うことになる。

【０００９】従って、ブロードキャストやマルチキャストのように、同一内容のパケットを複数の端末に同時に送信する同報通信を行う場合、従来の技術によれば、ＳＴＰのプロトコル処理部が、同一パケットのコピーを無線インタフェース用の複数の論理ポートに転送し、論理ポート毎に異なる中継先アドレスを付与した複数のＭＡＣフレームを無線インタフェースから送信し、中継先の各無線ブリッジが、自分宛のＭＡＣフレームを受信処理し、受信ＭＡＣフレームから抽出した元の同報パケットをそれぞれのＬＡＮセグメントに転送することになる。この場合、中継元となった無線ブリッジからは、中継先アドレスを変えた複数のＭＡＣフレームが繰り返して送信されるため、無線区間におけるトラフィックの増加と、各無線ブリッジにおけるメッセージの転送効率の低下を招くと言う問題が発生する。

【００１０】また、無線区間では、環境の変化によって通信品質が変動する。このため、各無線ブリッジにおい

て、通信可能な範囲内に位置する周辺の複数の無線ブリッジと対応して、上述した論理ポートを予め固定的に割り当てた場合、通信品質の劣化による受信エラーの発生に伴ってメッセージ再送要求が頻発し、これが無線区間におけるトラフィックの増加とメッセージの転送効率の低下を招くと言う問題もある。

【００１１】本発明の目的は、無線区間におけるメッセージの転送効率に優れた無線ブリッジを提供することにある。本発明の他の目的は、無線インタフェースに対する論理ポートの割り当てを適切に行える無線ブリッジを提供することにある。本発明の更に他の目的は、特にブロードキャストやマルチキャスト等の同報パケットを効率的に送信できる無線ブリッジを提供することにある。

【００１２】

【課題を解決するための手段】上記目的を達成するため、本発明の無線ブリッジは、通信可能範囲に位置する他の無線ブリッジの中から、通信品質が所定レベル以上のもの選択して、スパニングツリープロトコル（ＳＴＰ）の適用対象となる接続ブリッジとすること、および、複数の無線ブリッジにブロードキャストまたはマルチキャストすべきパケットに対して、ブロードキャストまたはマルチキャストアドレスを中継先アドレスとしたＭＡＣヘッダを付与し、無線インタフェースから同報パケットとして送出することを特徴とする。

【００１３】更に詳述すると、本発明による無線ブリッジは、周辺に位置する通信可能な他の無線ブリッジの中から、通信品質に従って接続すべきブリッジを選択し、各接続ブリッジに論理的なポート識別子を付与するための手段と、ブリッジ内のネットワークセグメント用に割り当てられたポート番号および上記論理的なポート識別子とに対応して用意された複数の送／受信バッファと、上記各受信バッファに格納されたパケットを宛先アドレスによって特定される何れかの送信バッファに転送する転送制御手段と、他のネットワークセグメントとの間で、上記何れかの送／受信バッファと上記無線インタフェースとを介してパケットを送受信するための手段とを備えたことを特徴とする。

【００１４】本発明の１つの特徴は、特定の論理ポート識別子と対応した同報通信用の送信バッファを用意することによって、ブロードキャスト用またはマルチキャスト用のパケットを同時に複数の接続ブリッジに送信することにある。

【００１５】

【発明の実施の形態】以下、本発明の無線ブリッジをＩＥＥＥ８０２．１１規格の無線ＬＡＮに適用した場合について説明する。ＩＥＥＥ８０２．１１は、無線ＬＡＮの物理レイヤとＭＡＣ（Media Access Control）レイヤについての規格であり、ＭＡＣレイヤは、ＯＳＩ参照モデルにおけるデータリンクレイヤの下層と対応している。

【００１６】図１は、本発明の無線ブリッジが適用される無線ＬＡＮの１例を示す。無線ＬＡＮは、複数の無線ブリッジ１０－ｉ（ｉ＝１～５）からなり、各無線ブリッジ１０－ｉは、有線ＬＡＮｉを介して複数の端末ＰＣｉ１、ＰＣｉ２、…と接続され、それぞれのネットワークセグメントを形成している。

【００１７】図２は、上記無線ＬＡＮにおいて、無線ブリッジ間で交信されるＩＥＥＥ８０２．１１で規定されたＭＡＣフレーム１００のフォーマットを示す。ＭＡＣフレーム１００は、ＭＡＣヘッダ１１０と、本体フレーム１２０と、ＦＣＳ１３０とからなる。本体フレーム１２０には、各有線ＬＡＮ（ネットワークセグメント）で通信されるパケット、例えば、Ethernetフレームが設定される。

【００１８】ＭＡＣヘッダ１１０は、フレーム制御情報１１１、送信完了までの所要時間（継続時間：Duration/ID）を示す期間情報１１２、アドレス１：１１３、アドレス２：１１４、アドレス３：１１５、シーケンス制御情報１１６、アドレス４：１１７の７つのフィールドからなっている。

【００１９】ここで、括弧内に示した数字は、各フィールドの長さ（オクテット数）を示しており、各アドレスフィールドには、６オクテットのＭＡＣアドレスが設定される。ＭＡＣアドレスの上位３オクテットは、通信機器メーカに固有のコードを示し、残りの３オクテットは、各通信機器またはインタフェースに固有の値となっている。

【００２０】アドレスフィールド１１３、１１４、１１５、１１７に設定されるアドレス内容は、フレーム制御情報１１１に含まれるTo ＤＳビットとFrom ＤＳビットの組み合せによって異なる。ここで、ＤＳは、Distribution Systemの略号であり、ＩＥＥＥ８０２．１１以外のＬＡＮとの接続部、例えば、有線ＬＡＮとの接続インタフェースを意味している。

【００２１】無線ブリッジ１０で、有線ＬＡＮ間のパケットを中継する場合は、図３の付属テーブルでTo ＤＳビット＝“１”、From ＤＳビット＝“１”の欄に示すように、アドレスフィールド１１４には無線区間での送信元（中継元）ＭＡＣアドレス：ＴＡ（transmitter address）、アドレスフィールド１１３には無線区間での宛先（中継先）ＭＡＣアドレスＲＡ（receiver address）、アドレスフィールド１１７にはパケットの送信元端末のＭＡＣアドレスＳＡ（source address）、アドレスフィールド１１５にはパケットの宛先端末のＭＡＣアドレスＤＡ（destination address）が設定される。

【００２２】各無線ブリッジでは、無線インタフェースからの受信パケットに付されたＭＡＣヘッダのＴＡアドレスとＳＡアドレスを参照することによって、各論理ポートと対応する接続無線ブリッジおよび端末のＭＡＣアドレスを知ることができる。

【００２３】図３は、ネットワークトポロジーを認識するために無線ブリッジ間で送受信されるＢＰＤＵ（bridge protocol data unit）フレームのフォーマットを示す。ＢＰＤＵフレームは、プロトコルＩＤ２０１と、プロトコルバージョンＩＤ２０２と、ＢＰＤＵタイプ２０３と、フラグ２０４と、ルートＩＤ２０５と、ルートパスコスト２０６と、ブリッジＩＤ２０７と、ポートＩＤ２０８と、メッセージ・エージ２０９と、ＭＡＸエージ２１０と、ハロータイム２１１と、フォワードディレイ２１２からなっている。

【００２４】ＳＴＰでは、ネットワーク内でブリッジ優先度の値が最も低い無線ブリッジが、ルートブリッジとなって、ルートブリッジの各ポートから上記ＢＰＤＵフレームを送信する。上記ルートブリッジに接続された各ブリッジは、受信したＢＰＤＵフレームのルートパスコスト２０６に自ブリッジのルートポートのパスコストを加えて、受信ＢＰＤＵフレームを他のブリッジに中継する。各ブリッジは、自ブリッジの各ポートから受信したＢＰＤＵフレームのルートパスコスト２０６を参照することによって、ルートブリッジまでの最適な経路を判断する。また、冗長経路があった場合は、パスコストの大きいポートをブロックすることによって、効率的な経路を設定する。

【００２５】図４は、本発明による無線ブリッジ１０の１実施例を示す。無線ブリッジ１０は、無線送受信回路１１と、変復調回路１２と、ＭＡＣ制御部１３と、ブリッジ内のネットワークセグメントに接続される有線ＬＡＮインタフェース１４と、プロセッサ１５と、ユーザインタフェースとなる入出力装置１６と、プログラム格納用のメモリ１７と、データ格納用のメモリとからなる。

【００２６】データ格納用のメモリには、送信バッファエリア１８、受信バッファエリア１９、ルーティングテーブル２０、パラメータテーブル３０、アドレステーブル４０、接続テーブル５０が形成される。また、プログラム格納用のメモリ１７には、ＯＳ６１の他に、本発明に関係する主要なプログラムとして、例えば、ブリッジプロトコル処理ルーチン６２、網構成制御ルーチン６３、送信処理ルーチン６４、受信処理ルーチン６５が用意されている。

【００２７】プロセッサ１５は、内部バス６９を介して変復調回路１２、ＭＡＣ制御部１３および有線ＬＡＮインタフェース１４と接続され、後述するように、ブリッジプロトコル処理ルーチン６２、送信処理ルーチン６４、受信処理ルーチン６５を実行することによって、上記ＭＡＣ制御部１３と有線ＬＡＮインタフェース１４との間でのパケットの転送を制御する。また、プロセッサ１５は、網構成制御ルーチン６３を実行することによって、上記ＭＡＣ制御部１３と連携して網構成情報の収集とテーブル情報の更新を行い、無線ブリッジにおける経路設定、ネットワーク障害検出、迂回路の設定などの機能を実現する。

【００２８】図５は、ルーティングテーブル２０の構成を示す。ルーティングテーブル２０は、各無線ブリッジが備える入出力ポートのポート番号２１と、ブリッジＩＤ２２と、宛先アドレス（端末アドレス）との対応関係を示しており、各ポート番号２１と対応して、接続ブリッジのＩＤ２２と、該接続ブリッジにおいてネットワークセグメントを形成する複数の端末のアドレス（宛先アドレス）２３が記憶されている。

【００２９】ポート番号２１は、無線インタフェース、すなわち、無線送受信回路１１、変復調回路１２、ＭＡＣ処理部１３からなる回路系に関しては、接続ブリッジと対応して割り当てられた論理ポート番号と、後述する同報通信（ブロードキャスト／マルチキャスト）用に割り当てられた論理ポート番号とが含まれる。また、同報通信用のポート番号と対応する接続ブリッジＩＤ２２には無意味な値が設定され、宛先アドレス２３には、ブロードキャスト／マルチキャスト用のアドレスが設定される。

【００３０】図６は、パラメータテーブル３０の構成を示す。パラメータテーブル３０は、上記ルーティングテーブル２０に登録されたポート番号２１と対応する複数のサブテーブル３０－１～３０－ｍからなる。各サブテーブル３０－ｉには、パラメータ情報として、例えば、ポートＩＤ３１と、ステータス３２と、パスコスト３３と、ルート側ブリッジＩＤ：３４と、接続ブリッジＩＤ：３５と、ルートパスコスト３６とが記憶される。

【００３１】ポートＩＤ３１は、無線ブリッジ１０内のポートを識別するためのＩＤであり、有線ＬＡＮインタフェース１４に割り当てられた実ポートＩＤ（ポート番号）の他に、無線インタフェースに割り当てられた複数の論理ポートＩＤ（論理ポート番号）を含む。

【００３２】ステータス３２は、Listening、Learning、Forwarding、Blockingの４つの状態コードで各ポートの現在の状態を示す。Listeningは、ネットワークトポロジーと最適パスを設定するためにブリッジがＢＰＤＵを送受信している状態を示す。Listening状態にある時、そのポートよりも優先度の高いパスが見つかった場合は、Blocking状態に遷移し、そのポートからのデータ転送はブロックされる。Listening状態でそのポートより優先度の高いパスが見つからなかった場合は、Learning状態に遷移し、パス情報がForwarding Tableに登録される。Learning状態で、予め決められ時間（Forward Delay Time）が経過すると、Forwardingに遷移し、そのポートで通常のデータ転送が行われる。

【００３３】パスコスト３３は、そのポートに接続されるインタフェースの通信速度を表しており、一般的に、通信速度の早いインタフェースほどパスコストの値が小さくなっている。例えば、ＩＥＥＥ８０２．１Ｄでは、インタフェース速度が１０Mb/sのパスコストを「１０

０」、１００Mb/sのパスコストを「１９」とすることが推奨されている。

【００３４】ルート側ブリッジＩＤ３４と接続ブリッジＩＤ３５として設定されるブリッジＩＤの値は、ブリッジ優先度とブリッジＭＡＣアドレスとを合わせたものとなっている。ネットワーク中で、上記ブリッジ優先度が最低値となっているブリッジがルートブリッジとなる。ルート側ブリッジＩＤ３４には、そのポートから見て、ネットワークトポロジー上でルート側に隣接するブリッジのＩＤが設定され、接続ブリッジＩＤ３５には、そのポートに実際に接続されているブリッジのＩＤ、または論理ポートに対応付けられた周辺の無線ブリッジのＩＤが設定される。ルートパスコスト３６は、ルートブリッジからそのポートまでのパスコストの合計値を示しており、その値は、前述したＢＰＤＵフレームから判明する。

【００３５】アドレステーブル４０には、その無線ブリッジに割り当てられたアドレス（以下、自アドレスと言う）用のテーブルと、同報通信用のアドレステーブルとが登録されている。図７は、同報通信用のアドレステーブル４１を示す。同報通信用のアドレステーブル４１には、ブロードキャスト、マルチキャストの区別を示すラベル４１Ａと対応して、そのブリッジで有効となる同報ＭＡＣアドレスの値４１Ｂが登録されている。

【００３６】各無線ブリッジ１０は、後述する受信処理ルーチン６５によって、無線インタフェースから受信したＭＡＣフレーム中の中継先アドレスＲＡを上記アドレステーブル４０の登録アドレスと比較する。中継先アドレスＲＡが自アドレスまたは同報通信用の何れかのアドレスと一致した場合、受信フレームがブリッジプロトコル処理部６２に渡され、宛先アドレスと対応したポートに転送処理される。また、後述するように、ブリッジプロトコル処理部６２が同報通信用の論理ポートに出力したパケットについては、宛先アドレスを上記同報通信用のアドレステーブル４１に登録された同報用アドレスと照合し、アドレスを確認した上で同報用ＭＡＣヘッダが付与され、無線インタフェースに転送される。

【００３７】図８は、接続テーブル５０の構成を示す。接続テーブル５０は、無線インタフェースを介して通信すべき他の無線ブリッジ（接続ブリッジ）を特定するためのものであり、送受信可能な範囲に位置する他の無線ブリッジのＭＡＣアドレス５１と対応して、信号の受信レベル５２と、接続の可否を示すフラグ情報５３とが記憶されている。

【００３８】本発明では、各無線ブリッジ１０において、周辺に位置する他の無線ブリッジのうち、信号の受信レベルが予め決められた閾値以上の無線ブリッジのみを接続可能な無線ブリッジと判断し、これらの無線ブリッジをＳＴＰの対象ブリッジに選定して、論理ポート番号の割り当てとパラメータ用サブテーブル３０の生成を行う。

【００３９】すなわち、本発明では、各無線ブリッジが初期設定された時点で、周辺の無線ブリッジをスキャンし、通信可能な無線ブリッジを検出する。周辺に位置する無線ブリッジのスキャン方法としては、例えば、周辺の各無線ブリッジが発生するビーコンフレームを一定時間モニタすることによって、通信可能な無線ブリッジを検出するパッシブスキャンと、初期設定された無線ブリッジ側からプローブフレームを送信し、周辺の各無線ブリッジから返送されるプローブ・レスポンスフレームを受信して、通信可能な無線ブリッジを検出するアクティブスキャンとがある。

【００４０】アクティブスキャンを採用した場合、周辺の他の無線ブリッジから送信されたプローブ・レスポンスフレームの無線信号は、図４に示した無線送受信回路１１で受信され、変復調回路１２で復調された後、ＭＡＣフレームとしてＭＡＣ制御部１３に入力され、プロセッサ１５に通知される。また、上記無線信号の受信レベルは、例えば、変復調回路１２で測定され、ＭＡＣ制御部２３を介してプロセッサ１５に通知される。パッシブスキャンで受信したビーコンフレームと、変復調回路１２で測定した無線信号の受信レベルについても、上記と同様に、ＭＡＣ制御部２３を介してプロセッサ１５に通知できる。但し、受信レベルについては、変復調回路１２からプロセッサ１５に直接取り込むようにしてもよい。

【００４１】プロセッサ１５は、初期設定時に網構成制御ルーチン６３を実行することによって、周辺無線ブリッジのスキャン結果を解析し、周辺無線ブリッジのＭＡＣアドレスと受信レベルとの関係を示す接続テーブル５０を生成する。

【００４２】網構成制御ルーチン６３では、上記接続テーブル５０に登録されたエントリを受信レベルの高い順にソートし、周辺の無線ブリッジのうち、受信レベルが予め設定した閾値レベルよりも高いものについて、フラグ情報５３を接続可の状態に設定する。受信レベルが閾値レベルよりも低い無線ブリッジについては、フラグ情報５３を接続否の状態に設定することにより、ＳＴＰの対象外とする。この場合、不要トラフックの発生を抑制する目的で、接続可能な無線ブリッジの個数に上限値を設定しておき、受信レベルが閾値レベル以上の無線ブリッジの中から、受信レベルが高い順に、限定された個数の無線ブリッジを選択するようにしてもよい。

【００４３】上述した周辺無線ブリッジのスキャンデータは、ＭＡＣ制御部１３として、例えば、Ｉｎｔｅｒｓｉｌ社の無線ＬＡＮメディアアクセスコントローラ：ＨＦＡ３８４１を採用し、プロセッサ１５からＭＡＣ制御部１３に指令することによって収集できる。また、初期設定時に限らず、スキャンデータを周期的に収集することによって、ネットワークトポロジーのダイナミックな

変更に適合できる。

【００４４】本発明では、各無線ブリッジが、上述した受信レベルによって選択された特定の無線ブリッジを接続ブリッジとして、論理ポートＩＤの割り当てとパラメータ用のサブテーブルの生成を行い、経路設定などの構成制御を実行する。

【００４５】例えば、図１に示した無線ＬＡＮにおいて、無線ブリッジ１０－１が、無線ブリッジ１０－２と１０－３を接続ブリッジとして選択し、無線ブリッジ１０－２が、無線ブリッジ１０－１、１０－３、１０－４、無線ブリッジ１０－３が、無線ブリッジ１０－１、１０－２、１０－４、０１－５、無線ブリッジ１０－４が、無線ブリッジ１０－２、１０－３、１０－５、無線ブリッジ１０－５が、無線ブリッジ１０－３、１０－４をそれぞれ選択したと仮定する。また、各ブリッジの優先度から、無線ブリッジ１０－１がルートブリッジとなり、各ブリッジ内では複数の論理ポートが同一のパスコストを持つものと仮定した場合、図１の無線ＬＡＮと対応するＳＴＰトポロジーは、図９のようになる。

【００４６】各無線ブリッジ１０－ｉ（ｉ＝１～５）では、ＳＴＰのプロトコル処理機能に従って、自ブリッジ内の各論理ポートのルートパスコストを評価し、冗長パスをブロックする。この結果、例えば、ブリッジ１０－２と１０－３との間のパスＰ５と、ブリッジ１０－４と１０－５との間のパスＰ８に接続される論理ポートがブロックされ、パラメータテーブルに反映される。

【００４７】また、ブリッジ１０－２と１０－４との間のパスＰ４と、ブリッジ１０－３と１０－４との間のパスＰ６は、ルートパスコストが同一になるため、これらのパスに接続されたブリッジ１０－４では、接続ブリッジＩＤ順、ポートＩＤ順に若い方のポートをフォワーディングポートとして選択する。例えば、ブリッジ１０－３のＩＤがブリッジ１０－２のＩＤよりも若いＩＤとなっていた場合は、パスＰ４の接続ポートがブロックされる。

【００４８】但し、システム全体の負荷バランスを考えた時、ブリッジ１０－４では、パスＰ４を残して、パスＰ６をブロックした方がよい場合もある。このような場合、例えば、各無線ブリッジにおいて、物理無線インタフェースのパスコストをその物理無線インタフェースに対応する論理ポートの個数で補正した値を各論理ポートのパスコストとして採用すればよい。

【００４９】例えば、ブリッジ１０－２では、一つの無線インタフェースが３つの論理ポートが対応しているため、各論理ポートのパスコストを１００に設定し、一方、ブリッジ１０－３では、一つの無線インタフェースに４つの論理ポートが対応しているため、論理ポートのパスコストをブリッジ１０－２よりも高い値、例えば、１５０に設定する。このようにすると、パスＰ４のルートパスコストが、パスＰ６のルートパスコストよりも小さくなるため、ブリッジ１０－４にパスＰ４を選択させ、パスＰ６をブロックさせることが可能となる。

【００５０】尚、接続無線ブリッジからの受信レベルの高い順に論理ポートＩＤを設定しておけば、パスコストが同一の複数のパスが存在した時にポートＩＤの若い方を選択することによって、回線状態の優れたパスをフォワーディングポートとして残し、回線状態の悪いパスを自動的にブロックすることが可能となる。

【００５１】以下、図１０と図１１を参照して、本発明の無線ブリッジ１０におけるパケット転送動作について説明する。図１０は、図３に示したブリッジプロトコル処理ルーチン６２、送信バッファエリア１８、受信バッファエリア１９、送信処理ルーチン６４、受信処理ルーチン６５、テーブル２０～４０の関係を示している。

【００５２】送信バッファエリア１８と受信バッファエリア１９には、各ポートと対応して、ポート０用の送信バッファ１８－０／受信バッファ１９－０～ポートm用の送信バッファ１８－m／受信バッファ１９－mが形成される。本実施例では、接続ブリッジへの論理ポート番号の割り当てを容易にするため、有線ＬＡＮインタフェース１４にポート番号０を割り当て、同報通信（ブロードキャスト／マルチキャスト）用に論理的なポート番号１を割り当て、無線インタフェースを介して接続される他の無線ブリッジとの通信用に論理的なポート番号２～ｍを割り当てているが、ポート番号の割り当て順序には特に制約はない。

【００５３】同報通信（ブロードキャスト／マルチキャスト）用には、送信バッファのみが必要であり、図ではポート番号１の受信バッファが省略されている。また、図１０では、図面表記の都合上、送受信処理ルーチン６４、６５を、有線ＬＡＮ用の送受信処理ルーチン６４Ａ、６５Ａと、無線インタフェース（ＭＡＣ処理部１３）用の送受信処理ルーチン６４Ｂ、６５Ｂに分けて示してある。

【００５４】ブリッジプロトコル処理ルーチン（以下、ブリッジプロトコル処理部と言う）６２は、ＩＥＥＥ８０２．１Ｄで規定されたＳＴＰの機能を備えており、有線ＬＡＮインタフェース１４および無線インタフェース（ＭＡＣ制御部）１３を介して受信されるパケットのＭＡＣアドレスを学習し、各インタフェースのポート番号、接続ブリッジＩＤ、受信パケットの送信元アドレスの関係をルーティングテーブル２０に記憶する。また、ＳＴＰによる経路設定に応じて、ポート別のパラメータテーブル３０の内容を適宜更新する。

【００５５】有線ＬＡＮインタフェース１４から受信されたパケットは、受信処理ルーチン６５Ａによって、有線ＬＡＮインタフェース１４と対応するポート番号０の受信バッファ１９－０に格納され、信号線６５０で示すように、受信処理ルーチン６５Ａからブリッジプロトコル処理部６２に、上記ポート番号０を示した受信イベン

トが発行される。

【００５６】上記受信イベントに応答して、ブリッジプロトコル処理部６２は、受信イベントが指定するポート番号０の受信バッファ１９－０から受信パケットを読出し、ルーティングテーブル２０から上記受信パケットの宛先アドレスと対応するポート番号ｊを検索する。ルーティングテーブル２０に受信パケットの宛先アドレスと対応するポート番号が登録されていなければ、受信パケットは廃棄される。

【００５７】宛先アドレスと対応するポート番号ｊが判明すると、ブリッジプロトコル処理部６２は、受信パケットをポート番号ｊもつ送信バッファ１８－ｊに送信パケットとして格納した後、信号線６４０で示すように、ポート番号ｊを示す送信イベントを送信処理ルーチン６４Ｂに発行する。受信パケットが同報パケットの場合は、同報通信用の送信バッファ１８－１に格納され、ポート番号１を示す送信イベントが発行される。

【００５８】一方、無線インタフェース（ＭＡＣ制御部１３）から図２に示したＭＡＣフレームが受信されると、受信処理ルーチン６５Ｂは、受信フレームのＭＡＣヘッダが示す中継先アドレスＲＡ（Receiver Address）と、アドレステーブル４０に登録された自ブリッジアドレス４２とを照合する。ＲＡと自ブリッジアドレスが一致した場合、受信処理ルーチン６５Ｂは、パラメータテーブル３０から、上記ＭＡＣヘッダの中継元アドレスＴＡ（Transmitter Address）と一致した接続ブリッジＩＤ３５をもつサブテーブル３０－ｋを検索し、受信フレームの本体フレームフィールド１２０から抽出したパケットを上記サブテーブル３０－ｋのポートＩＤ３１が指定するポート番号ｋを持つ受信バッファ１９－ｋに格納した後、ブリッジプロトコル処理部６２に対して、上記ポート番号ｋを示す受信イベントを発行する。

【００５９】受信フレームの中継先アドレスＲＡが自ブリッジアドレスに一致しなかった場合、受信処理ルーチン６５Ｂは、上記ＲＡをテーブル４１に登録された同報通信用のＭＡＣアドレスと照合する。ＲＡが登録された何れかの同報アドレスと一致した場合は、受信処理ルーチン６５Ｂは、上述した自ブリッジ宛の受信フレームと同様、パラメータテーブル３０から、中継元アドレスＴＡと一致した接続ブリッジＩＤ３５をもつサブテーブル３０－ｋを検索し、受信フレームから抽出したパケットを上記サブテーブル３０－ｋのポートＩＤ３１が指定するポート番号ｋを持つ受信バッファ１９－ｋに格納した後、ブリッジプロトコル処理部６２に対して、上記ポート番号ｋを示す受信イベントを発行する。

【００６０】受信フレームのＲＡが、アドレステーブル４０に登録された自ブリッジアドレスと同報通信用のＭＡＣアドレスの何れにも不一致の場合、受信フレームは廃棄される。

【００６１】ブリッジプロトコル処理部６２は、上記ポート番号ｋの受信バッファに格納された受信パケットについて、上述したポート番号０の受信パケットと同様の処理を行う。これによって、中継先アドレスＲＡが自ブリッジ宛の受信パケットと同報通信用の受信パケットが、有線ＬＡＮインタフェース用のポート番号０をもつ送信バッファ１８－０に格納され、送信処理ルーチン６４Ｂに対して上記ポート番号０を示す送信イベントが発行される。また、受信バッファ１９－ｉ（ｉ＝２～ｍ）から取出された同報通信用のパケットについては、そのコピーを送信バッファ１８－１にも格納することによって、更に他の無線ブリッジに伝播させることが可能となる。

【００６２】図１１は、上記ブリッジプロトコル処理部６２が発行する送信イベントに応答して実行される送信処理ルーチン６４（６４Ａ、６４Ｂ）のフローチャートを示す。送信処理ルーチン６４では、送信イベントで指定されたポート番号ｉをもつ送信バッファ１８－ｉから送信パケットを読出す(ステップ６４１)。送信イベントで指定されたポート番号ｉが同報通信のポート番号（＝１）の場合は(ステップ６４２)、送信パケット（例えば、Ethernetフレーム）の宛先アドレスを同報通信用アドレステーブル４１に登録されたブロードキャスト用およびマルチキャスト用のＭＡＣアドレスと照合し（ステップ６４３）、不一致の場合は、何もせずに（パケットを廃棄）、送信処理を終了する。

【００６３】宛先アドレスがブロードキャスト用またはマルチキャスト用の何れかのＭＡＣアドレスに一致した場合は、ＭＡＣヘッダ１１０のＤＡアドレスフィールド１１５とＲＡアドレスフィールド１１３に上記宛先アドレス、すなわち、ブロードキャスト／マルチキャスト用のアドレスを含むＭＡＣフレームを作成し（ステップ６４４）、該ＭＡＣフレームをＭＡＣ制御部１３に送出して（ステップ６４５）、送信処理を終了する。この場合、ＭＡＣヘッダのＴＡアドレスフィールド１１４には、自ブリッジアドレスが設定され、ＳＡアドレスフィールド１１７には、送信パケットに付されたＳＡアドレスの値が設定される。

【００６４】上記送信イベントで指定されたポート番号ｉが、無線インタフェース用の何れかのポート番号（＝２～ｍ）の場合（ステップ６４６）、上記ポート番号ｉと対応するサブテーブル３０－ｉにおいて接続ブリッジＩＤ３５が示すＭＡＣアドレスをＲＡアドレスフィールド１１３に設定したＭＡＣフレームを作成し（ステップ６４７）、該ＭＡＣフレームをＭＡＣ制御部１３に送出して（ステップ６４５）、送信処理を終了する。この場合、ＭＡＣヘッダのＤＡアドレスフィールド１１５には、送信パケットのＤＡアドレスの値が設定され、ＴＡアドレスフィールド１１４とＳＡアドレスフィールド１１７には、上記同報通信用のＭＡＣヘッダと同様の値が設定される。

【００６５】送信イベントで指定されたポート番号ｉが、同報通信用の論理ポート番号（＝１）にも、無線インタフェース用の他の論理ポート番号（＝２～ｍ）の何れにも該当しない場合（本実施例では、有線ＬＡＮインタフェース用のポート番号０の場合）は、送信フレームを有線ＬＡＮインタフェース１４に送出して（ステップ６４９）、送信処理を終了する。

【００６６】以上の実施例から明らかなように、本発明の無線ブリッジでは、周辺に位置する他の無線ブリッジのうち、通信品質が保証されたものを接続ブリッジとして選択し、これらの接続ブリッジをＳＴＰの対象ブリッジとして論理ポート番号を割り当て、ＳＴＰ転送制御用のパラメータテーブルを生成している。また、同報通信（ブロードキャスト／マルチキャスト）に専用の論理ポート番号を割り当て、ブロードキャスト／マルチキャスト用のパケットについては、上記専用ポートを介して送信処理するようにしている。従って、本実施例によれば、無線区間における通信エラーが少なく、複数の接続ブリッジに対して同報通信用のパケットを１回の送信処理で送信できるため、ブリッジプロトコル処理部および無線区間におけるメッセージ（パケット）の転送効率を大幅に改善できる。

【００６７】尚、図１０の実施例では、各ポート番号ｉと対応して専用の送信バッファ１８－ｉを設けたが、ブリッジプロトコル処理部６２からは、送信パケットとポート番号を示す送信イベントとが対をなして出力されるため、実際の応用においては、図１０に示した送信バッファ１８－０～１８－ｍを１つの送信パケットキューにまとめ、送信処理ルーチン６４が、送信イベントキューからの送信イベントの読み出しと、上記送信パケットキューからの送信パケットの読み出しとを交互に繰り返すようにすればよい。

【００６８】同様に、受信処理ルーチン６５からも、受信パケットとポート番号を示す受信イベントとが対をなして出力されるため、図１０も示した受信バッファ１９－０、１９－２～１９－ｍを１つの受信パケットキューにまとめ、ブリッジプロトコル処理部６２が、受信イベントキューからの受信イベントの読み出しと、上記受信パケットキューからの受信パケットの読み出しとを交互に繰り返すようにすればよい。

【００６９】また、実施例では、無線インタフェースと有線ＬＡＮインタフェースをそれぞれ１つずつ備えた無線ブリッジについて述べたが、各無線ブリッジが、例えば、周波数多重による複数の無線インタフェースを備えた場合も、本発明を適用できること明らかである。

【００７０】実施例では、無線ブリッジ毎に有線ＬＡＮによるネットワークセグメントを形成しているが、ネットワークセグメントのうちの少なくとも１つが、無線ブリッジと無線で交信する複数の無線端末からなるシステム構成としてもよい。また、実施例では、ＩＥＥＥ８０２．１１の無線ＬＡＮにおいて、８０２．１Ｄのプロトコル処理を行う場合について説明したが、本発明は、実施例以外の他のプロトコルにも適用可能である。

【００７１】

【発明の効果】本発明によれば、通信品質によって接続ブリッジを選択して無線ＬＡＮを構成しているため、通信不良による不要なトラフィックを抑止できる。また、複数の接続ブリッジに対して、同報通信用のパケットを１回の送信処理で送信できるため、ブリッジプロトコル処理部および無線区間におけるメッセージ（パケット）の転送効率を大幅に改善できる。

【図面の簡単な説明】

【図１】本発明の無線ブリッジが適用される無線ＬＡＮの１例を示す図。

【図２】無線ブリッジ間で交信されるＭＡＣフレームのフォーマットを示す図。

【図３】ネットワークトポロジーを認識するために送信されるＢＰＤＵ（Bridge Protocol Data Unit）のフォーマットを示す図。

【図４】本発明による無線ブリッジの１実施例を示す図。

【図５】図４に含まれるルーティングテーブル２０の構成を示す図。

【図６】図４に含まれるパラメータテーブル３０の構成を示す図。

【図７】図４のアドレステーブル４０に含まれる同報通信用アドレステーブル４１の構成を示す図。

【図８】図４に含まれる接続テーブル５０の構成を示す図。

【図９】図１の無線ＬＡＮと対応するＳＴＰトポロジーの１例を示す図。

【図１０】本発明の無線ブリッジにおけるパケットの転送動作を説明するための図。

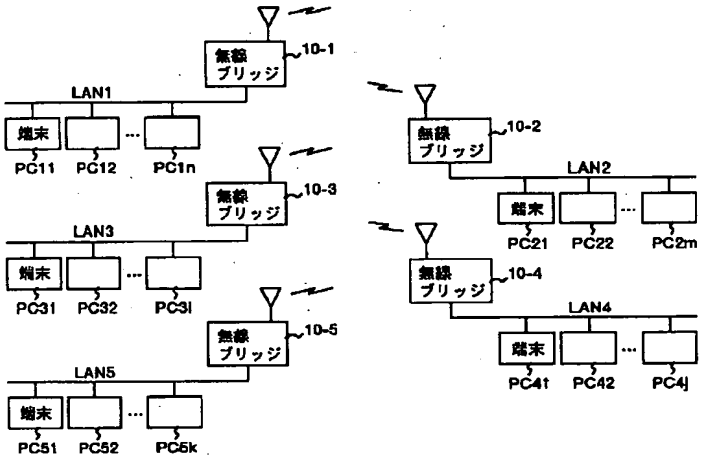
【図１１】パケット送信処理ルーチン６５の機能を示すフローチャート。

【符号の説明】

１０－１～１０－５：無線ブリッジ、ＰＣ１１～ＰＣ５ｋ：端末装置、１１：無線送受信回路、１２：変復調回路、１３：ＭＡＣ制御部、１４：有線ＬＡＮインタフェース、１５：プロセッサ、１６：入出力装置、１７：プログラムメモリ、１８：送信バッファ、１９：受信バッファ、２０：ルーティングテーブル、３０：パラメータテーブル、４０：アドレステーブル、４１：同報通信用アドレステーブル、４２：自ブリッジアドレス、５０：接続テーブル、６１：ＯＳ、６２：ブリッジプロトコル処理ルーチン、６３：網構成制御ルーチン、６４：送信処理ルーチン、６５：受信処理ルーチン。

【図１】

図 1



【図２】

図 2

MACフレーム 100

110							120	130
MAC ヘッダ							本体フレーム	FCS
フレーム制御 (2)	期間 (2)	アドレス1 (6)	アドレス2 (6)	アドレス3 (6)	シーケンス制御 (2)	アドレス4 (6)		
111	112	113	114	116	116	117		

111A	111B	113	114	115	117
To DS	From DS	アドレス1	アドレス2	アドレス3	アドレス4
0	0	DA	SA	BSSID	N/A
0	1	DA	BSSID	SA	N/A
1	0	BSSID	SA	DA	N/A
1	1	RA	TA	DA	SA

【図３】

図 3

BPDU 200

201	202	203	204	205	206	207
ﾌﾟﾛﾄｺﾙ ID	ﾌﾟﾛﾄｺﾙ ﾊﾞｰｼﾞｮﾝ ID	BPDU ﾀｲﾌﾟ	ﾌﾗｸﾞ	ﾙｰﾄ ID	ﾙｰﾄ ﾊﾟｽｺｽﾄ	ﾌﾞﾘｯｼﾞ ID

208	209	210	211	212
ﾎﾟｰﾄ ID	ﾒｯｾｰｼﾞ ｴｰｼﾞ	MAX ｴｰｼﾞ	ﾊﾛｰ ﾀｲﾑ	ﾌｫﾜｰﾄﾞ ﾃﾞｨﾚｲ

【図５】

図 5

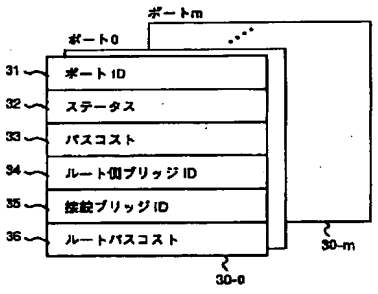
ルーティングテーブル 20

21	22	23
ポート番号	ブリッジ ID	宛先アドレス

【図６】

図 6

パラメータテーブル 30



【図８】

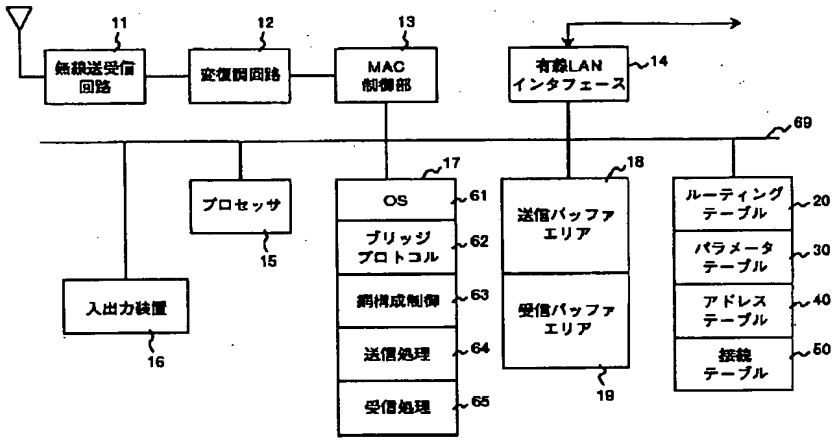
図 8

接続テーブル 50

51	52	53
MACアドレス	受信レベル (dBm0)	接続可否
00-22-33-00-00-11	-70	1
00-22-33-00-00-12	-80	1
00-22-33-00-00-15	-100	0

【図４】

図 4



【図７】

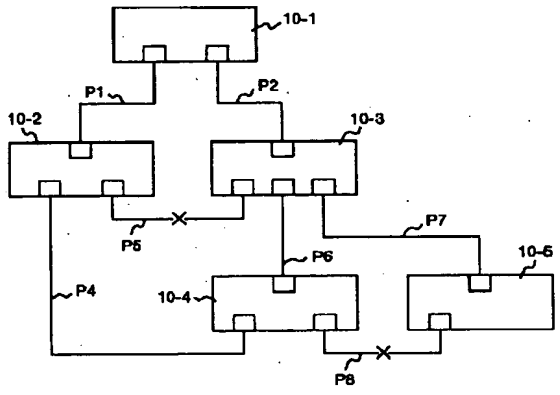
図 7

同報通信用アドレステーブル 41

41A ラベル	41B MACアドレス
ブロードキャストアドレス	FF-FF-FF-FF-FF-FF
マルチキャストアドレス１	FF-22-33-00-00-11
〃 2	FF-22-33-00-00-12
〃 3	FF-22-33-00-00-15
⋮	⋮

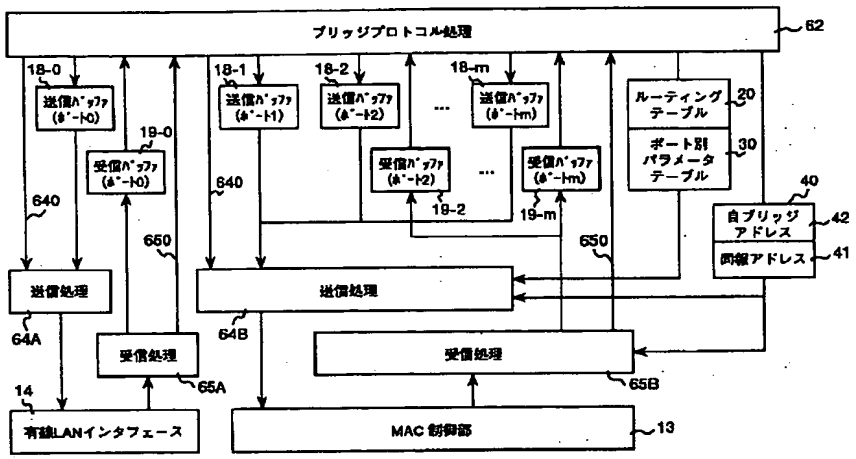
【図９】

図 9



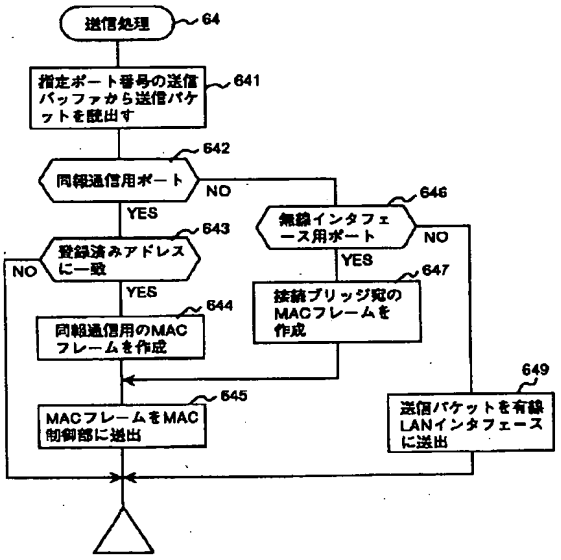
【図１０】

図 １０



【図１１】

図 １１



フロントページの続き

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EA02
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